AVIATION

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Volume 43 • Number 11

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McGRAW-HILL PUBLISHING CO., INC. Publication office 99-129 North Broadway, Albany, N. Y. Return postage guaranteed. Editorial and executive offices, 330 West 42nd Street, New York, 18, N. Y. Branch offices: Chicago, 520 North Michigan Ave.; San Francisco, 68 Post Street; Aldwych House, Aldwych, London, W.C. 2; National Press Bldg., Washington; 16 South Broad St., Philadelphia; Hanna Bldg., Cleveland; 2-144 General Motors Bldg., Detroit; Paul Brown Bldg., St. Louis; 1427 Statler Bldg., Boston; Rhodes-Haverty Bldg., Atlanta; 621 S. Hope, Los Angeles; 738-9 Oliver Bldg., Pittsburgh. JAMES H. McGRAW, Founder and Honorary Chairman; JAMES H. McGRAW, Jr., President; HOWARD EHRLICH, Executive Vice-President for Business Operations; JOHN ABBINK, Executive Vice-President for Editorial Operations; CURTIS W. McGRAW, Vice-President and Treasurer; JOSEPH A. GERARDI, Secretary; J. E. BLACKBURN, Jr., Director of Circulation, Aviation, 330 W. 42nd Street, New York. Published monthly, price 50c a copy, 50c in Canada. Allow at least ten days for change of address. All communications about subscriptions should be addressed to Director of Circulation, 330 West 42nd Street, New York. Subscription rates—United States, Mexico and Central American Countries, $3.00 a year, $4.00 for two years, $5.00 for three years. Canada, $3.50 for one year, $5.00 for two years, $6.00 for three years, payable in Canadian currency at par. Great Britain and British Possessions 30 shillings per year, 60 shillings for three years. All other countries, $5.00 a year, $10.00 for three years. Entered as second-class matter September 3, 1936, at the Post Office, Albany, New York, under the Act of March 3, 1879. Volume 43, Number 11. Printed in U. S. A. Cable Address: "McGrawhill New York." Member A.B.C.

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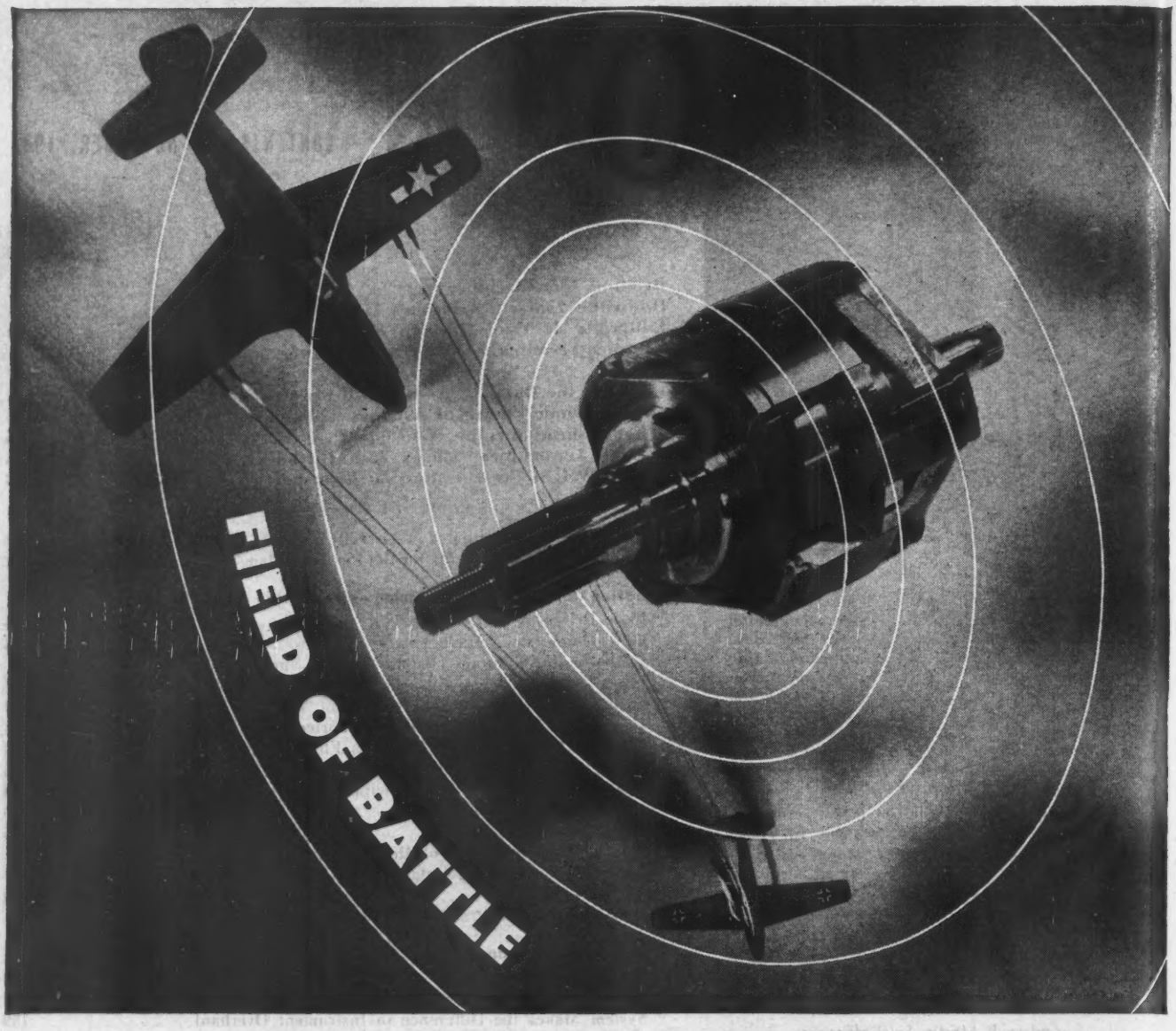

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Briefing for November

How to come through contract terminations without going bankrupt is a question causing more gray hairs than anything else in the industry today. Since it's more than vital that this country have an aircraft industry after the war, J. Carlton Ward has gone to bat and come up with a tangible program by which government can do its part to keep this industry solvent. It's on page 110.

AVIATION is particularly pleased, this month, to launch a series on helicopter design which will fill a serious need in the scant literature on rotary wing design. Joseph S. Pecker, a veteran in the field, inaugurates this series with a down-to-earth presentation on power transmission for single rotor, bi-axial, and co-axial craft, and it's illustrated according to our usual standards. Page 125.

Chet Ricker, our Detroit Editor, recently spent a quiet Sunday making a thorough study of Hitler's nastiest—the V-1 buzz bomb. And when Chet makes a study, that includes his inimitable sketches. There are a lot of things revealed as the result of this so-called day of rest. See page 190.

Aircraft accessory manufacturers are finding that their postwar marketing problems have as many kinks as do those of the engine and airframe producers, and exactly what sales setup to use is one of the biggest and toughest puzzles, they report, Arthur S. Brown, sales manager of Scott Aviation Corp., says there's a place for the distributor in accessory marketing; he gives his reasons on page 121.

And speaking of accessories, should anything except the basic engine instruments be considered accessories on personal planes? Frederick H. Smith, of Sperry, tackles this one—also in our Marketing Section—giving his ideas in his article beginning on page 122.

An ingenious mechanization of heliarc welding has meant more than just whipping a tough long-seam job in Curtiss-Wright's St. Louis plant—it also forecasts important production savings in the coming peace. How the job was licked at C-W is told in the article starting on page 134.

The veteran transocean pilot, James B. Rea—now engineering test pilot for Convair—really knows the importance of the fuel vs. payload question. This month he presents a quick method of determining in a hurry, but with complete accuracy, just what to do when the inevitable point-of-no-return is reached. Turn to page 178.

And for the other extreme on transport operations—the short hauls of pickup flights—there's a well rounded story giving details of equipment developed by All American Aviation. Page 170.

COMMANDO IN PEACETIME GARB. Re-touched photo showing how Curtiss-Wright CW-20E—postwar airline version of C-46—will look as re-designed for commercial service. Other photographs and drawings, also all available details, will be found on page 120.

Come the end of the war, more and more fixed base operators are going to start figuring the dollars but close as they try to reduce maintenance costs. John Brennan and Ralph Hall, of American Export Airlines, have made a thorough study of finish factors, and what they found is of vital profit-and-loss importance, not only to every airline but also to every man who maintains planes of any size. Page 163.

And also in the usual well-rounded maintenance section is a profusely illustrated article giving details on many time and money saving tools developed around the country by Air Service Command (now part of ATSC); how Embry-Riddle runs instruments through overhaul, with details on many equipment features they built themselves; Lockheed's new maintenance-simplifying service forms; how Canada's RCAF whips the snow problem; and the always-practical Maintenance Notebook.

Financing and insuring the personal planes will, everyone hopes, be a lot bigger business—and a lot more standardized—than it's ever been before. Oliver Parks has worked out arrangements with a bank and insurance underwriter which sets a very definite and practical pattern for local personal plane financing by dealers and distributors everywhere. See page 185.

Down the Years in AVIATION'S Log

25 Yr. Ago (1919) —Post Office announces record of 8,988 mi. per forced landing for past six months, "a very respectable figure" . . . Authorities say variable pitch propeller "seems to have possibilities" . . . Zeppelin Lindau builds 100-ft.-span 4-engine monoplane flying boat with 70 hr. fuel capacity . . . Twin-Liberty-engine Lawson transport carries two pilots and 24 passengers . . . Upson, in Goodyear II, wins first postwar balloon race, traveling 1,050 mi. . . . Navy offers 215 seaplanes and 367 engines for sale.

15 Yr. Ago (1929)—National Air Tour (5.017 mi.) completed by 24 of 29 starting planes . . . Columbus, Ohio, opens first air-rail airport alongside Penn RR. . . . Guggenheim gives another $500,000 to assist aviation; gifts now total $3,000,000. . . . Army orders $1,642,383 planes and parts. . . . Savoia-Marchett's U.S. sales total 105 planes costing $1,685,582 in year. . . . Sikorsky opens new plant at Bridgeport. . . . New York City Police force has 25 trained pilots. . . . Navy asks $6,000,000 for improvements at Pensacola. . . . U.S. now has 83 college flying clubs. . . . Airmail rates to Latin America reduced. . . . Big Ten universities use planes to transport football teams.

10 Yr. Ago (1934)—Scott and Black fly deHavilland Comet from England to Australia in 52 hr., beating former record by 57 hr. . . . Hammond Aircraft wins D. of C. small aircraft competition. . . . Hugo Eckener comes to U.S. to arrange for Zeppelin terminal. . . . Four women pilots fly across continent in formation. . . . Capt. Irving Chambers, developer of catapult for shipboard launchings, dies.

HELICOPTER INSTRUMENTS are called upon to indicate performance of a nature different from that generally associated with the operation of conventional airplanes. Kollsman has already devised a special dual tachometer and synchroscope for experimental helicopter work. A super-sensitive air speed indicator is also called for, because of the helicopter's ability to move at low lateral speeds. The ship's ability to hover and to make slow descents also suggests refinements in rate-of-climb indicators. Whatever the ultimate instrument requirements of the helicopter, Kollsman engineers will be ready with practical and efficient designs, keeping pace, as always, with every advancement in the science and the art of operation.

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It Takes HUMAN RELATIONS

TENSION WAS HIGH in the president's outer office. A report had just come in that labor organizers were standing outside the plant gates handing out circulars to the incoming employees. The guardians of the chief executive buzzed among themselves. Who was to bear the brunt of the executive explosion which was sure to follow? Finally the first assistant screwed up courage to enter the inner sanctum. He laid the report before the boss, braced himself for whatever was to come, and then received the shock of his life.

"Arrange for a general meeting of all our employees within an hour. Cancel all my appointments for this morning. Go out to the main gates and escort the gentlemen with the circulars to this office at once."

The first assistant gaped, managed to mumble a "Yes, sir," and set out to perform this unusual task. In due course, the labor men arrived. The president greeted them cordially and invited them to occupy his most luxurious chairs. He abandoned the austerity of his desk and sat down in the circle with them, saying:

"Fellows you have made your work unduly difficult by trying to reach our employees outside the plant. That was completely unnecessary in this organization. We operate here as a democracy and we are more than eager to preserve the principles of free speech. I have arranged for an immediate general meeting of the employes at which you are invited to present your case under conditions befitting the dignity of your message. I shall introduce you to our group at that meeting."

The labor men looked at each other in silence. They were even more deeply shocked than the first assistant had been. After the meeting came the crucial test. The employees voted almost unanimously against joining the labor organization.

THE FOREGOING PARABLE is not a dream. It is a true story. It has happened once and it can happen again. The moral is as simple as the eleven short words of the golden rule. But how many presidents are handling their industrial relations that way? And how many boards of directors would approve of that kind of action if they were consulted. Decidedly too few is the answer.

There is a pitiable lack of thoughtful human relations in the vast majority of management today. True there is plenty of paternalism in industry. The industrial community is full of house organs, group insurance policies, service pins, gold watches and similar things which have a definite and an important place. But they are not enough—not nearly enough.

The executive who has the heaven-sent gift of making the most lowly floor-sweeper feel that his job is most vital to the company is the most highly prized possession of any organization anywhere. The pat on the back, the interest in the new baby or the ailing wife must be sincerely felt if they are to be effective. The gift for the baby, the flowers for the wife should come first from management and later from fellow employees. These are but a few of the little things that cost so little in cash and effort, but mean so very much to the fellow who receives them.

EXECUTIVES not blessed with the ability to think about these little things as well as big ones, should be honest with themselves and admit it to themselves. They should surround themselves with one or more associates who have this important work as their chief assignment, because it is the most important job in any company—large or small. If the working force is so large that one person is not enough to do this work and do it well, more personnel should be added.

You may call this industrial relations, personnel relations, or any other name, but it is far more than all of these. It is human relations. It is the practical application of the poet's human touch. It is simply treating the other fellow as if he were a human being like yourself.

In the industrial period that has just passed, much of the strife and unrest and defeat that management has suffered at the hands of labor could have been avoided or substantially softened by this simple formula. In the era that lies ahead it will be very much more important. It will be so vital, in fact, that unless management accepts its full responsibility in this direction, the very survival of our system of private industry is in grave doubt.

Leslie E. Neville

EDITOR

Contract Termination—Key to Airpower and Security

By **J. CARLTON WARD, JR.,** *President, Fairchild Engine & Airplane Corp.*

Solvency of the aircraft industry—and with it our means to maintain the peace—depends on successful administration of the War Contracts Settlement Act. Here an aviation leader presents a tangible program for such administration.

CONTRACT TERMINATION will take this country in one of two directions: To leading airpower for America, or to a repetition of that unhappy condition in which the nation found itself after World War I. The latter predicament continued right up until 1940, when France and England spent large sums of money here trying to bolster their own war machines.

We in the aviation industry who are responsible for our respective solutions to the problems presented fear that under present conditions we may not have the resources to assure the nation of the air power essential to security.

This fear for survival may appear groundless from a cursory glance of aircraft balance sheets. But a study of the Harvard report—"The Financial Position of the Aircraft Industry"—will quickly show the weakness of our stand. We who must administer these companies are frightened by the prospects we face. These prospects are even more sobering in view of the fact that military leaders consider our industry an integral part of the air forces.

Fortunately, however, these military leaders want to administer our industry *out* of the war on the same plane and under the same policies used to get it *into* the war. Going into the war, it will be remembered, verbal requests were frequently accepted by the industry for huge monetary commitments long before they could be covered by the ever-necessary paper work. Nothing was allowed to prevent production aimed to guarantee the nation's survival.

Now the Army intends to honor those commitments as production is demobilized. This means negotiated settlements in the spirit of the broad objectives of the War Contract Settlement Act of 1944, and not through the administration of complex accounting details and hair splitting.

The near-tragic example of the last war's methods provides the best warning for avoidance of the complex-hair splitting method. Then the majority of airframes were produced by aircraft companies, but the automobile companies produced most of the engines. Forty percent of Army expenditures for planes and engines went to regular aviation companies. Curtiss Aeroplane & Motor Corp.; Wright-Martin Co.; Dayton-Wright Co.; and Standard Aircraft Co. represented 72 percent of all planes and engines bought by the Army from regular aircraft manufacturers. These same companies also received substantial Navy orders.

Here, under the last war's settlement policies, is what happened to those companies:

Curtiss had sales of approximately $6,000,000 in 1916 . . . $46,000,000 in 1918 . . . and $1,261,000 in 1921. In 1923 the company was "reorganized," a polite way of saying it underwent a major operation, coming out with new balance sheets.

Wright-Martin was also reorganized, most of the assets being sold to International Truck Corp., with the engine business taken over by Wright Aeronautical Corp.

Dayton-Wright ceased building planes. It became a facility of General Motors, and so passed out of the aircraft picture.

Standard went out of business, as did such smaller organizations as Sturtevan, Burgess, and West Virginia.

This, then, is what happened to 72 percent of the aviation industry under the then-existing contract settlement legislation.

What happened to general business during that time? In the five years prior to 1914, there were between 12,000 and 16,000 business failures per year, for in this country we have failures in good times as well as bad. In 1919 they were down to 6,500, but by 1921—after the war—they had popped up to 20,000. More important, however, is the fact that total liabilities of the failing companies prior to the war had been about $200,000,000 a year; by 1921 they hit a high of $627,000,000.

Even many companies which did not go out of business had to undergo radical financial changes. A study by the National City Bank of New York covering the reorganization of 65 manufacturing companies during the 1920's shows their assets before reorganization were $2,559,000,000—and afterward were only $1,270,000,000. In other words, they wrote off half their total assets.

And what of profits? Government representatives today persist in talking about net profits "before taxes," but there is no such thing as profits before taxes—except to the Treasury. Industry has no profit until after it has paid its taxes.

Examination of the profit trends—after taxes—in World War I and II shows very clearly the precarious position the aircraft industry occupies today.

Total net profits of all American industry amounted to $2,370,000,000 in 1914, reaching $7,300,000,000 in 1917. Then they dropped rapidly until, in 1921, total net profits were down to only $24,000,000.

Taxes, during that period, started at 1 and 2 percent of net corporate income. Then came the excess profits tax legisla-

Prompt decisions are necessary.

Settlements should be made with a minimum of formula.

Give the contractor more latitude in settling subcontractors' claims.

Government should clarify cost-plus contract termination procedure.

tion of the last war, jumping taxes to 20 percent in 1917, to 38 percent in 1918, and back to 23.1 percent in 1919. After the war they were cut back to 16.2 percent in 1921, the year our total American business made only $24,000,000.

Total net income, after taxes, earned by all industry jumped from $4,000,000,000 in 1939, when World War II started, to a peak of $9,600,000,000 last year. One fact must, however, be kept in mind: Industrial production growth in this country between the wars was tremendous. Industrial production in 1943 was more than three times the 1919 output. Even if profits today are about equal dollar-wise to those of 1919, the profit per unit is only a third as much.

This is due largely to the changed tax structure, under which, in 1939, industry paid 23.36 percent of net income. This climbed to 59.7 percent in 1943 and is estimated at 61.34 percent this year.

A comparison of net profits-to-sales further clarifies the aircraft industry's precarious position. Last year its net income after all taxes amounted to only 1.8 percent of sales, while the iron and steel companies netted 2.8, railway equipment 3.1, automobiles 3.2, petroleum products 6.8, and nonferrous metals 9 percent.

The automobile industry makes an especially interesting comparison, for its profits, to a great extent, come from aircraft production. The automobile industry has done a magnificent job with designs developed in aircraft plants. But those designs could exist only through the efforts of the airplane industry's research and development. Yet the antomobile industry—whose peacetime demand grows larger every day—netted 3.2 percent on sales, the aircraft industry but 1.8 percent.

Through these figures can be traced American industrial history after World War I. They show that war profits in many cases are illusory.

If a speedy, secure termination procedure is not applied to all industry as it comes out of this war, thus assuring each manufacturer enough liquid assets to carry through the difficult reconversion period, industry's ability to carry forward and build a strong America will be seriously impaired.

In the case of the aircraft industry this problem is even more pressing, as the table above shows:

The aircraft industry's financial condition is weak compared with others, largely because it has been heavily penalized. Yet this is the industry that is being counted on to maintain American airpower. But without a constructive termination procedure, it is doubtful that the industry can fulfill the high mission set for it.

Aircrafts' Financial Position in 1942

Items	Composite of 11 Mfgrs.	Industrial Composite
Current assets to liabilities.	1.09	2.2
Net working capital to 1942 sales.....	5%	30%
Stockholders capital to sales	8%	69%
Stockholders capital to company-owned inventories...	48%	334%

The problem is one of statesmanship, and not one of enforcement of complex accounting regulations. The industry must be able to assume that the problem is being attacked in the spirit of the law, for the industry cannot feel that it is solvent until terminations have been made.

To help maintain that solvency, and with it the ability to keep America secure through possession of adequate airpower, these points are offered as a basis for termination action:

1. Termination and disposal officers should be able to make prompt decisions. Naturally, each officer assumes a rather humbling personal responsibility, but the responsibility for prompt action must transcend the personal position. Every effort should be made to avoid such instances as the case where a disposal officer was reluctant to authorize scrapping of castings and forgings of very special design even after the materials had already been determined to be surplus.

2. As urged by the Aeronautical Chamber of Commerce, settlements should be negotiated with a minimum of formula. This is important for, if we continue the present trend, we will soon find that termination negotiations will require *more* formulas, statements, costs, and, most important, greater delay in final settlement.

3. The contractor should be permitted greater latitude in settling subcontractor and vendor claims. This is the biggest job loaded on the contractor, for we must remember that national policy required the utilization of thousands of small shops, many of them ill-equipped from the standpoint of cost records. Thus, in many cases, the prime contractor must do most of the work of claim preparation. The job is almost too big to be handled with available manpower; it could be eased considerably if the contractor were allowed to settle many claims simply by using good judgment. In addition, government could assist greatly by inaugurating a further educational program directed to subcontractors, also vendors.

4. Cost-plus-fixed-fee contract termination procedure should be clarified. There is, for example, a case where the contract has been terminated but as yet the procedure has not been completely established by the government. In three or four months, however, the contract is quite liable to criticism for lack of progress in claim preparation. Establishment of a simple negotiated procedure will eliminate the CPFF procedure when a contract is terminated. Even a "fixed price" negotiation, leaving some risk with the contractor, might be desirable.

5. Consideration should be given to the problem of increased costs resulting from partial terminations. Such increased costs are due to the partial termination, but it is understood that the contractor, to obtain relief, must negotiate increased prices on the contract for the remaining undetermined quantities. Why make the contractor take on two negotiations when one could do the job? The whole thing could be done by the termination officer, or other designated official, working with the contractor on terminations.

6. Pre-planning of terminations is necessary. In one case, for instance, the need for spare parts was not considered until after the original termination had been made, necessitating revision of the whole schedule. In another case, a contract for engines was affected by five different termination notices. Obviously, when changes are made in the status of a termination, it is impossible to make proper material allocation and segregation. In such instances it would be advisable, therefore, to assume a date of termination and prepare claims based upon the status as of that time.

7. A simplified method of material inspection should be permitted. As related to work in progress, it would appear sufficient that the inspection be limited to count and extent of work completed (by operation, if possible). To the count could be applied a rate of rejection based upon past experience. This proposal would eliminate the need for a detailed inspection of each and every part, with attendant delay and cost.

8. Cooperation and coordination between the various government officials is, of course, important to the speed of settlement. Usually involved, for instance, are the inspection and disposal, accountability, and termination officers. Without coordination, the delays resulting from a technicality imposed by any one of them can slow—or even tie—up the work of the others.

Termination pre-planning is necessary.

Simplify inspection methods.

Government agencies must coordinate and cooperate.

Give 'Em the Data . . . And They'll Fix It—Fast

By **DICK D. MOYER,** *Service Engineer, Lockheed Aircraft Corp.*

Experience brought forth this service rep's cogent proposal to help Fourth Echelon maintenance men—who have shown unusual ingenuity—keep their fighting craft in the air.

. . . . *Fourth Echelon includes all operations necessary to completely restore worn or damaged aircraft to a condition of tactical serviceability, also the periodic major overhaul of engines, unit assemblies, accessories, and auxiliary equipment, with fabrication of such parts as may be required, accomplishment of technical compliance changes, and the recovery, reclamation, or repair of aircraft incapable of flight.*—ASC Liaison Functions, Page 136.

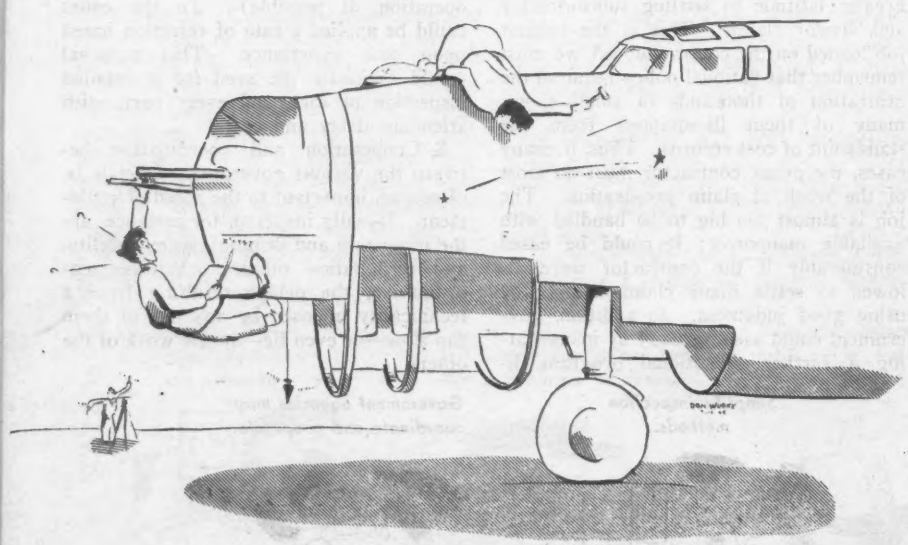
TO CARRY OUT its comprehensive operations, the Fourth Echelon base is set up and operated in a manner somewhat resembling an airframe manufacturing plant, the principal difference being the diversified nature of the work, consequent shorter "runs", and the unpredictable nature of the emergencies to be met.

And to accomplish its functions, the Fourth Echelon depot is provisioned with, and has available, all but one—and the most important, at that—of the facilities it needs. It has spare parts, tools, machinery, and raw stock—*but no tooling data.*

There are few who will question the value and probable need for tooling information where major overhaul and rebuilding of aircraft is done. But anticipating the normal reaction of production-wise readers—summed up, perhaps, in the question, "Is it proposed to virtually transport complete aircraft factories to Fourth Echelon bases?"—the answer is "No".

Fourth Echelon depots are small-scale airframe factories. They are not tooled for large volume production, but do have lathes, presses, drop hammers, milling machines, and many other machine tools necessary for fabrication of airframe structures. But while they are expected to fabricate and assemble airframe parts and assemblies, they do not, as we have said, have routine access to one of the most vital keys to solution of the problems they must solve—tooling data. Yet such data exists, and could quite easily be made available.

No new department would be necessary to handle the data. No fleet of ships would be required to transport it. And no great libraries of blueprints would have to be established all over the world. In fact, data could be supplied, on request, in microfilm form. With our present globe-girdling Army and Navy air transport services, the 25 to 200 lb. of tooling data, manuals, gages, and occasional copies of master tooling required for an accurate, speedy job—all could be delivered anywhere in a few hours, 24 to 100 at most.



"Parts were assembled in the ship, using plumb bobs, levels, transits, and the like, to align them—a very slow method."

Such service could be put into effect by requests from proper military authorities to make available such information and tooling, together with instructions to the transport commands to haul it. Requested by wire or cable, the few pounds of vital data, gages, or pieces of special tooling required where mating areas of assemblies are involved, could soon be on the way.

Such a system would save weeks, and in many instances months, of delay in getting sorely-needed combat aircraft back into the air. It would save vast amounts of shipping space now devoted to assembled parts and components. It would save materials now discarded because they cannot be reworked in depots, for lack of vital data. And it would save untold man-hours devoted to the fabrication, assembly, and transport of spare parts—many of which will never be used—now needed to stock bases.

From my personal experience, which includes a considerable amount accumulated at several overseas bases, and that of other field service men with whom I have talked shop, it is my observation that the "manufacturing" functions of Fourth Echelon depots constitutes the largest portion of their activity. For example, consider the actual problems encountered, in a typical instance, at a depot in East Africa, and the advantages which accrued as a result of methods followed.

When a heavy bomber bashed its nose section, more than two months were required to rebuild and replace it. Other instances of delay as long as five months were on record—delays waiting for bulky, fragile assemblies to be shipped from the states. One plane out of service for two, three, or even five months, was not important. But, if 25 heavies were out of service, because of wrecked nose sections, delays of even two weeks, rather than two months, could be critical.

And that would have been exactly the case had it not been for some ingenious

(*Turn to page* 269)

The Economic Future Of Aviation Technology

Analyzing the operating expenses of those transport planes —both immediate postwar and future postwar — designed to utilize propeller-turbine power plants.

PART III

By FREDERIC FLADER,
President, Frederic Flader Co., Consulting Aeronautical Engineers

DEVELOPMENT OF THIS ANALYSIS of the trend of airline operating costs for passengers and cargo has shown (Part II, Page 118, Aug. AVIATION) a possible reduction from 58c. per ton-mile to a new rate of about 35c. per ton-mile. These figures drew a comparison between the ton-mile charge for air express in 1940 and a probable figure for a postwar type of conventional design (Design C), which may be available approximately five years after the war.

The possibilities for cost reduction in the airplane itself, as distinguished from ground and overhead costs, lies in the improvement of its structural weight efficiency, its aerodynamic efficiency, and in power plant performance. The Design C airplane of Part II incorporates structural and aerodynamic refinements which are foreseeable and which can be developed by designers within the time specified.

Improvements in power output, weight efficiency, fuel consumption, and arrangement of power plants have been a major factor in the steady progress made in the past in the over-all performance of aircraft.

This progress is continuing with the four-cycle internal-combustion type of engine and will no doubt go on indefinitely. It is understood now how better materials can improve thermal efficiency. More efficient superchargers are on the way, and fan cooling offers a means for reducing cooling losses.

This article will survey the possibilities of the propeller-turbine type of power plant in relation to costs. It is not desired in any way to infer that the turbo engine will replace the internal combustion reciprocating type. This analysis may appear to be somewhat vulnerable to criticism because the postwar types described in Part II do not contemplate any improvements in internal combustion reciprocating power plants within the period of five years mentioned. This is admittedly not quite factual.

It is hoped that the reader will consider—if any comparisons are being made —that the figures already given are intended to show what performance may reasonably be expected from the presently available types of structure, aerodynamic design, and power plants. The results from the computations incorporating turbine engines may show a trend based

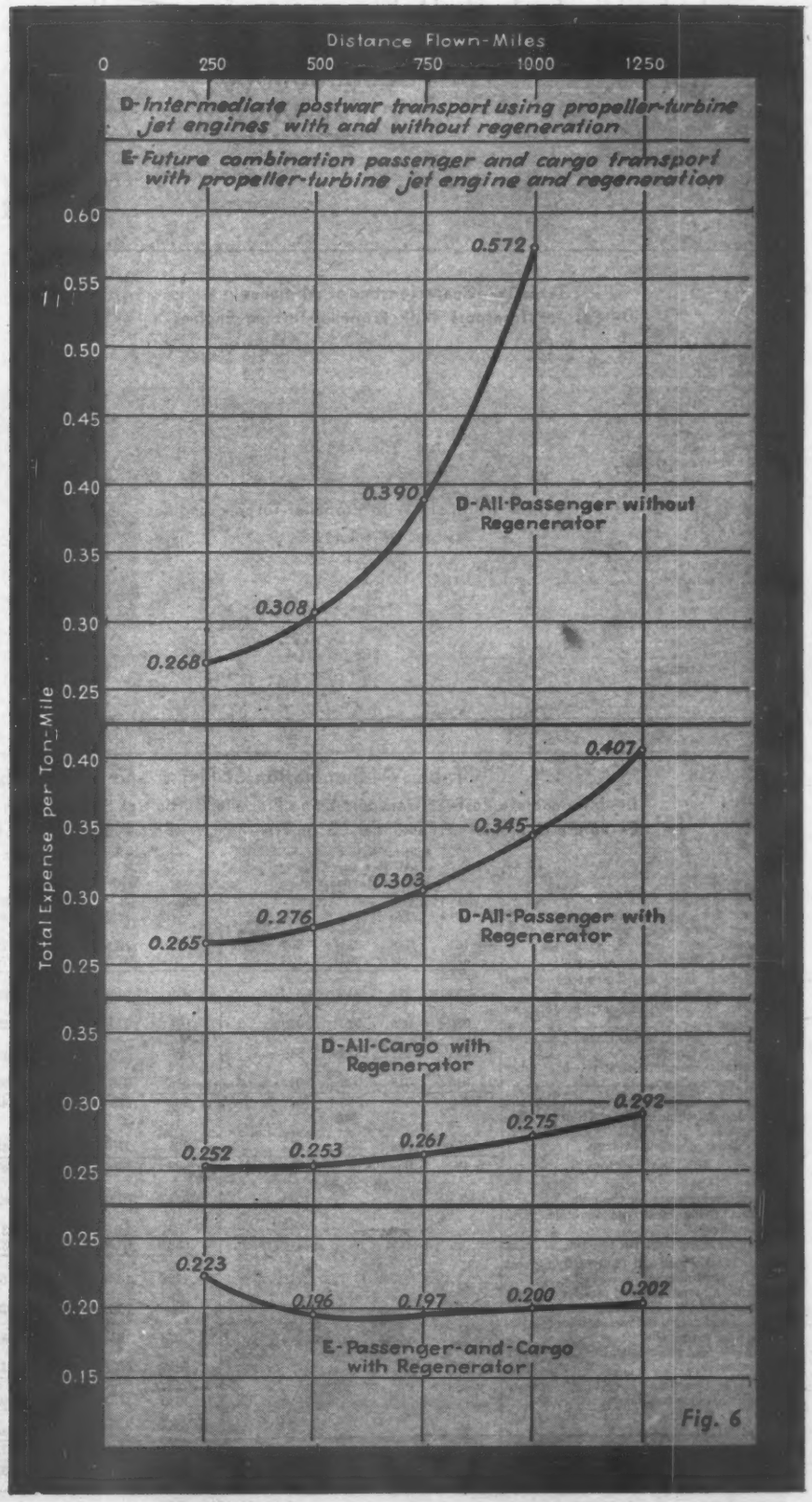


Fig. 6

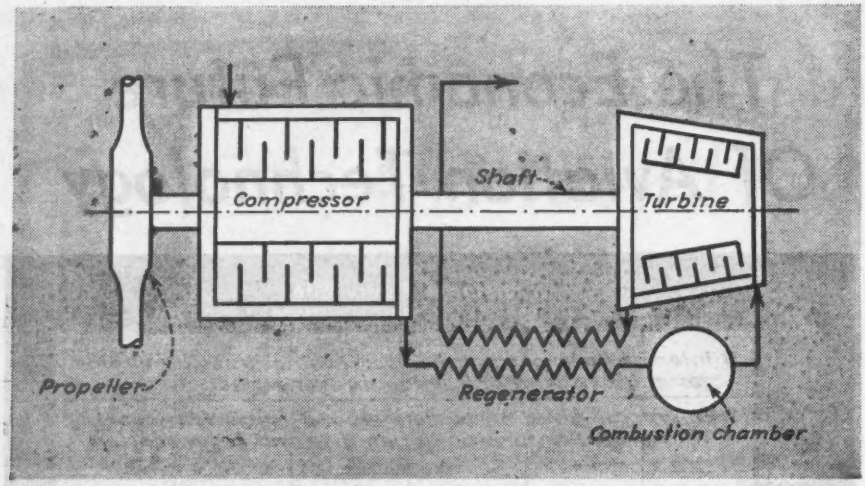


Fig. 7. As shown, propeller, air compressor and turbine are mounted on a common shaft. The combustion chamber and the regenerator complete essential units. Cycle of operation is as follows: (1) Air is taken in; (2) air is compressed; (3) air is passed through regenerator or heat exchanger and into combustion chamber where fuel is injected and burned (with enough fuel burned to raise temperature of air to a high value); (4) hot air and gas go through gas turbine, which furnished power to drive compressor and propeller; (5) gases from turbine pass through regenerator, where some of otherwise wasted heat is given up to incoming air, thereby raising over-all thermal efficiency of cycle; and (6) exhaust gases exit through tail pipe, contributing some jet thrust.

Table IV—Characteristics of Airplanes

D—Postwar Transport With Propeller-Turbine Engines

Gross weight	58,500					58,500				
Weight empty	40,750					36,430				
Useful load	17,750					22,070				
Number of passengers	61	54	47	39	32					
Capacity cargo in tons	.....	.....	.....	.....	.....	8.30	7.56	6.83	6.09	5.36
Capacity payload in tons	6.14	5.40	4.67	3.93	3.20	8.30	7.56	6.83	6.09	5.36
Crew	4	.....	.....	.....	.....	2	.....	.....	.....	.....
Block speed	188	205	211	214	216	188	205	211	214	216
Number of engines	2	.....	.....	.....	.....	2	.....	.....	.....	.....
Trip distance	250	500	750	1,000	1,250	250	500	750	1,000	1,250

E—Future Postwar Transport With Propeller-Turbine Engines

	Passenger-and-Cargo				
Gross weight	200,000				
Weight empty	100,000				
Useful load	100,000				
Number of passengers	200	100	100	100	100
Capacity cargo in tons	14.43	27.75	26.05	24.36	22.67
Capacity payload in tons	34.43	37.75	36.05	34.36	32.67
Crew	4	.....	.....	.....	.....
Block speed	215	237.5	246	250.5	253.5
Number of engines	4	.....	.....	.....	.....
Trip distance	250	500	750	1,000	1,250

entirely on the possibility of obtaining the performance as set forth.

A great deal has been written and published about the turbo-jet engine, therefore its component parts and cycle of operation are fairly well known. Fig. 7 is a diagram showing the components of a propeller-turbine type of engine which has been assumed as the installation in two airplane types to be described later.

The propeller-turbine engine briefly described in Fig. 7 is specified (Table IV) for both Designs D and E. The size of Desigt. D is such as to maintain reasonable wing and power loadings, and the design is one that should meet all the regulation requirements.

Design E is the same basic airplane as Design C in Part II of this series, except that the power plants have been changed from the conventional four-cycle internal-

Table V—Summation of Flying and Ground Expense

D—Intermediate Postwar Transport Using Propeller-Turbo Jet Engines With and Without Regeneration.

E—Future Combination Passenger-Cargo Transport With Propeller-Turbo Jet Engines and Regeneration.

	Intermediate Postwar All-Passenger Without Regenerator					Propeller-Turbo, Design D With Regenerator					Future Propeller-Turbo Transport, Design E With Regeneration				
Range in Miles	250	500	750	1,000	1,250	250	500	750	1,000	1,250	250	500	750	1,000	1,250
Direct flying costs per ton-mile	.1044	.123	.163	.254	.....	.103	.1093	.1245	.1487	.1856	.0467	.0382	.0387	.0399	.0414
Direct flying costs per ton-mile, 65% load factor	.161	.189	.251	.391	.....	.159	.168	.192	.229	.286	.0719	.0587	.0595	.0614	.0637
Indirect flying costs per ton-mile	.072	.082	.097	.129	.....	.071	.072	.074	.076	.078	.0485	.0352	.0355	.0362	.0365
Total direct and indirect flying cost per ton-mile	.233	.271	.348	.520	.....	.230	.240	.266	.305	.364	.1204	.0939	.0950	.0976	.1002
Traffic, & advertising expense/revenue ton-mile	.020	.020	.020	.020	.....	.020	.020	.020	.020	.020	.0530	.035	.036	.037	.037
Total direct, indirect, traffic, & adv./rev. ton-mile	.253	.291	.368	.540	.....	.250	.260	.286	.325	.384	.1734	.1289	.1310	.1346	.1372
General and administrative, 6% other expenses	.015	.017	.022	.032	.....	.015	.016	.017	.020	.023	.0140	.0074	.0079	.0081	.0082
Total airline oper. exp./rev. ton-mile	.268	.308	.390	.572	.....	.265	.276	.303	.345	.407	.1874	.1363	.1389	.1427	.1454
Ground handling expense (Railway Express)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.036	.060	.059	.058	.057
Total operating expense	.268	.308	.390	.572	.....	.265	.276	.303	.345	.407	.2234	.1963	.1979	.2007	.2024
Total payload, tons	6.42	5.05	3.68	2.31	.94	6.029	5.249	4.474	3.689	2.914	34.43	37.75	36.05	34.36	32.67
	All-Cargo														
Direct flying costs per ton-mile	.....					.0713	.0720	.0774	.0854	.0958	.....				
Direct flying costs per ton-mile, 65% load factor	.....					.1097	.1107	.1190	.1314	.1474	.....				
Indirect flying costs per ton-mile	.....					.0326	.0326	.6326	.0326	.0326	.....				
Total direct and indirect flying cost per ton-mile	.....					.1423	.1433	.1516	.1640	.1800	.....				
Traffic and advertising expense/revenue ton-mile	.....					.020	.020	.020	.020	.020	.....				
Total direct, indirect, traffic, & adv./rev. ton-mile	.....					.1623	.1633	.1716	.1840	.2000	.....				
General and administrative, 6% other expenses	.....					.0097	.0098	.0103	.0111	.0120	.....				
Total airline operating expense/revenue ton-mile	.....					.1720	.1731	.1819	.1951	.2120	.....				
Ground handling expense (Railway Express)	.....					.0800	.080	.080	.080	.080	.....				
Total operating expense	.....					.2520	.2531	.2619	.2751	.2920	.....				
Total payload, tons	.....					8.305	7.564	6.832	6.092	5.357	.....				

combustion type, currently available, to the propeller-turbine engines.

Cruising speeds for both designs have been selected at values somewhat higher than those for best economy or the greatest number of miles per gallon. There is a disadvantage in so doing from the standpoint of fuel costs and payload carried, but the over-all economy is slightly better owing to the marked influence of cruising speeds on operating costs.

The assumption of higher cruising speeds is on operating costs. The assumption of higher cruising speeds is believed to be justified from the standpoint of engine life and overhaul. This is due to the fact that the characteristics of the turbine engine permit operation at percentages of power closer to normal than is the case in conventional practice, at some sacrifice in fuel economy, but without exceeding allowable temperature limits.

Recovery of otherwise wasted heat will be an important consideration in the use of turbine engines. The use of the regenerator is not an essential part of the operation of this type of power plant. The same power could be generated without this interchange and recovery of heat, but this would be at the price of greatly increased fuel consumption, prohibitive for aircraft which are intended to carry satisfactory payloads over long distances.

The regenerator has the serious disadvantage of being very heavy and large in dimensions. The designer must evaluate the degree of regeneration on the basis of its economic value, using larger or smaller regenerators according to the performance specifications of his design. Information on this subject has been made available, and thus will not be discussed here.

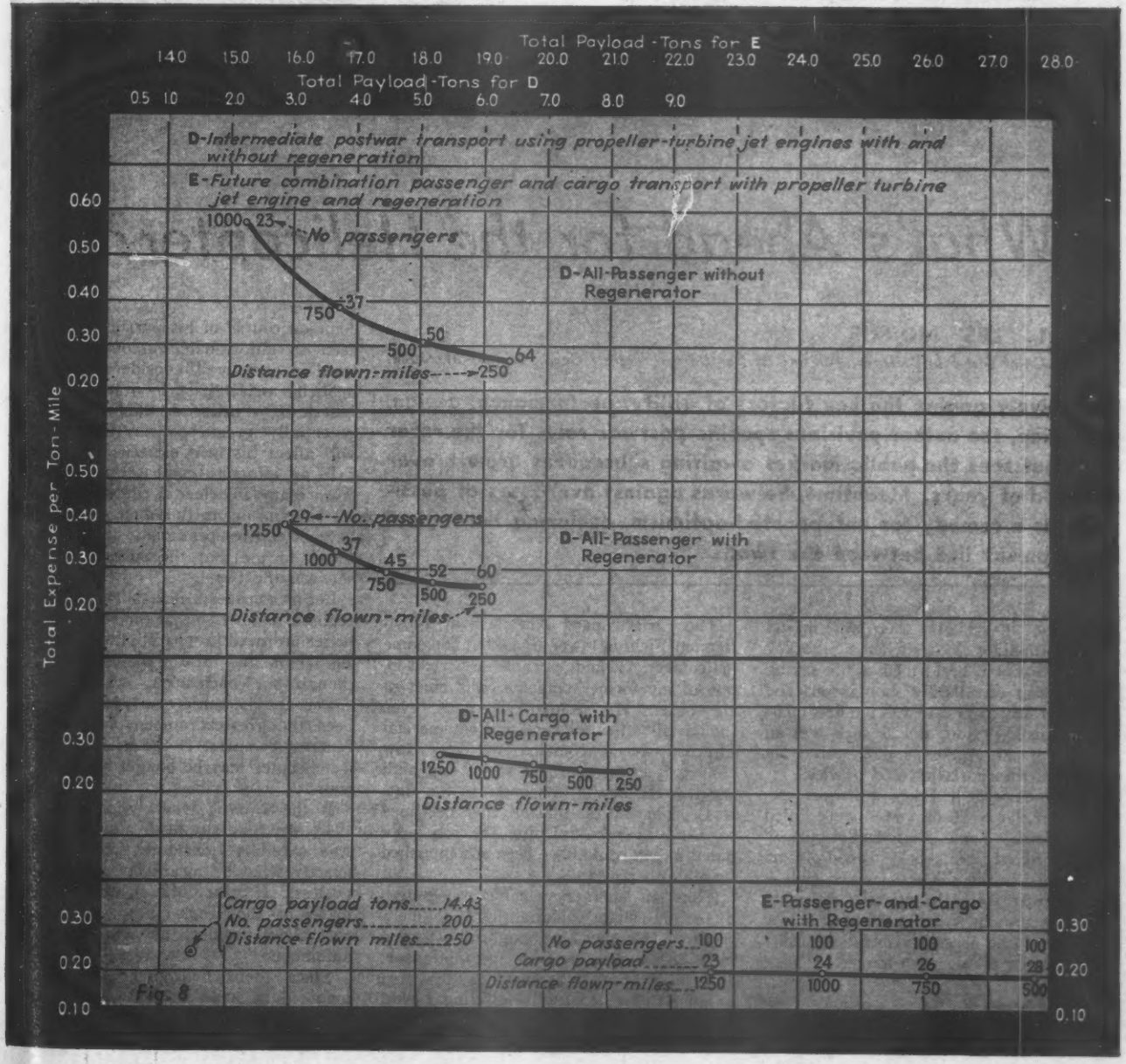
For purposes of comparison, the Design D airplane's operating costs have been computed with and without the use of regeneration. It has been assumed that 75 percent of the heat in the exhaust from the turbine is recovered in the regenerator.

Table V, which is similar to Table II in Part II, shows the computed operating expenses for all-passenger and all-cargo operation for the smaller of the two Design D airplanes. The costs for the large Design E craft are for a combination passenger and cargo service, as described for the similar Design C airplane in Part II of this series.

The curves of Figs. 6 and 8 show the results in graphic form. On an average flight of 750 mi., the possible cost of operation of the C airplane is 19.8c. per ton-mile. This is a reduction from the 1935-1944 transport of Part I of 16.65c. per ton-mile, or about 46 percent. This indicates the possibility of a new postwar rate of 31c. per ton-mile.

Referring again to Fig. 3 (Part I, June AVIATION), a probable market for 200,000,000 ton-miles is apparent at this price. This represents approximately 75 times the ton-miles of 1940.

This reduction of cost does not hold out the promise that air express will take the place of rail express for less than carload lot shipments, nor does it appear that this will be so within the foreseeable future. However, the possible gain in air express shipments is nonetheless quite substantial.



R-4B rotor ships for AAF under construction on world's first helicopter assembly line in Sikorsky Bridgeport plant. States the author: This is purely manufacture for the military. Broad civilian production, with prices commensurate, "will not be achieved soon after the war."

What's Ahead for the Helicopter?*

By C. L. "LES" MORRIS

Formerly Chief Test Pilot, Sikorsky Aircraft Div. of United Aircraft Corp., Bridgeport, Conn.

Objectively gaging the key factors of utility, performance, design, and price, the author envisions specific postwar roles for the rotor craft but sees the public market awaiting subsequent growth over a period of years. Meantime, he warns against overdoses of pessimism as a remedy for unsupported optimism, declaring the logical development lies between the two.

THE YEAR 1944 was still in its swaddling clothes when a Sikorsky helicopter performed a life-saving mission that was totally spontaneous and tragically necessary. It was the first completely unstaged job, and as such was an augury of an ever-expanding future in helicopter transportation and service.

On January 3, a Navy destroyer exploded off Sandy Hook. Men were killed and injured. Some were badly burned, others suffered from shock. Blood plasma was needed in the quickest way possible—but by boat from the Battery it would take over an hour to cross the bay, and by car it would be necessary to follow a circuitous route taking even longer.

The Coast Guard Air Base at Floyd Bennett Field in lower Brooklyn had some helicopters. Comdr. Frank A. Erickson, one of my former students, was chief of the base. He secured clearance, even though all other military and commercial aircraft were grounded by very low clouds, freezing rain and snow, and high winds. He flew a helicopter to the Battery, picked up the plasma, then bee-lined to Sandy Hook—finishing the job more quickly than could have been accomplished by any other means.

Thus, an emergency brings recognition of the immediate potentialities of the helicopter. However, a thoughtful warning may be sounded against over-optimism: In brief, it is not to be concluded that just because the helicopter is fulfilling a vital military service today, John Doe will be buying and flying one tomorrow in the common course of his pursuits. This has been an unfortunate misconception, fostered in part by ill-considered helicopter publicity and, in part, by John Doe's earnest desire to believe in the helicopter as a potentially great postwar industry that will affect his own existence.

In an effort to combat this over-optimism many informed writers and speakers have swung to the other extreme and have made over-pessimistic statements. It seems to me that the correct path lies between the two.

Let us consider a few salient points in a realistic manner so that the reader may be better prepared to separate the wheat from the chaff and to draw his own well-thought-out conclusions.

Perhaps the subject on which there has been the greatest amount of loose, unfounded comment is the price for which a helicopter may be bought after the war ends.

In the *Atlantic Monthly* for September, 1942, Mr. Sikorsky made a statement that was carefully considered and that said exactly what he meant to say—no more, no less. It was: "Manufactured by hundreds of thousands, the helicopter will cost about as much as a medium-priced automobile."

Since then, helicopter publicity has indulged in some luscious wishful-thinking, coming to a climax in a recent promise (made by one who had every-

* From the manuscript of the author's forthcoming book, "Pioneering the Helicopter" (McGraw-Hill Book Co.)

thing to gain and nothing to lose) that a postwar helicopter would sell for $995—not $996 or $994—but exactly $995! Let us endeavor to inject some sanity into this business of guessing at a price.

To begin with, can you confidently assert what a dollar will be worth after the war? Will a pair of shoes cost $6, or $2, or $20—or perhaps even more? Will a low-priced car still sell for $800?

With uncertainty as to the value of the dollar, it is downright foolishness to promise a fixed price for anything. Estimates should be made relative to some other commodity. That is why Mr. Sikorsky chose to say, "It will cost about as much as a medium-priced automobile." If a medium-priced automobile should sell for $6,000 after the war, this prophecy would still be within shooting distance.

But care should even be exercised in interpreting that word "medium-priced." It definitely does not mean "average-priced." On the basis of prewar dollar values, a high-priced automobile is around $3,000–$4,000; a low-priced one is around $900–$1,000. Therefore, "medium-priced" means something in the neighborhood of $2,000–$2,500. But let me emphasize again that dollar signs should not appear in this discussion. The safest statement is that, *if* a $2,200 prewar car still sells for $2,200 after the war, then, under certain circumstances, a helicopter may someday sell for about the same price.

What are those "certain circumstances"? Mr. Sikorsky says, "Manufactured by hundreds of thousands." That sounds simple, perhaps—but it isn't. Before our entrance into the war, the President shocked the aircraft industry by establishing a quota of 50,000 airplanes for a twelve-month period. This was more than all the airplanes we had ever built since the Wright brothers first flew at Kitty Hawk!

But note carefully that it was the responsibility of an *entire* industry to meet that figure. It did—by virtue of a perfectly tremendous effort.

Recent releases indicate that at present this country is producing about 9,000 airplanes a month. And when I say "this country," I mean all that it implies. After four hard years, a great, nation-wide industry, expanded to many times its prewar size, utilizing vast facilities of the automotive field, and working under extremes of war pressure with the maximum of priority, still has a cumulative output of only about 100,000 units a year—and even those units are divided among about 40 different types of aircraft.

If it has taken four years to accomplish this, how long will it take one individual company to reach the same production figure—much less the "hundreds of thousands" Mr. Sikorsky referred to? The answer is self-evident, at least in negation: It will *not* be achieved soon after the war.

The situation back of Mr. Sikorsky's statement might be clarified if it is realized that the automotive industry generally builds engines for about a dollar per horsepower. Aircraft engines, on the other hand, average about ten times this amount, although some afford cuts in horsepower costs to around $5–$6. When we consider that a decent two-to-three-place helicopter should have about 200 hp., it immediately becomes apparent that the engine alone is going to cost as much as the average person is planning to pay for the whole machine. Mass production may come to the rescue later on, but it is probable that, for quite a while, aircraft engines will continue to be higher priced than automobile engines.

If you proceed further and apply this type of analysis to the transmission, the main rotor and tail rotor blades, the hub mechanisms, the controls, the instruments, the landing gear, and the fuselage structure itself, you can appreciate Mr. Sikorsky's studied reasoning when he said: "Manufactured by hundreds of thousands, it will cost about as much as a medium-priced automobile."

What about performance—speed, range, and load? Here I always tread cautiously, surrounding each statement with carefully guarded qualifications. I remember that, about 1928, an eminent aeronautical engineer prepared and published an erudite dissertation proving conclusively that an airplane weighing more than 30,000 lb. could never leave the ground.

Yet we now see airplanes of twice and three times that size, and we confidently expect that they will exceed 100 tons, or even 500 tons when the economic need arises.

The fallacy of this 1928 forecast was that it did not take into account future research and development. If it had started by saying, "On the basis of present knowledge . . . ," it would have been on tenable ground.

In surveying the helicopter's future, that qualifying phrase assumes even greater significance. It is apparent that striking successes have been achieved to date with a most elementary knowledge

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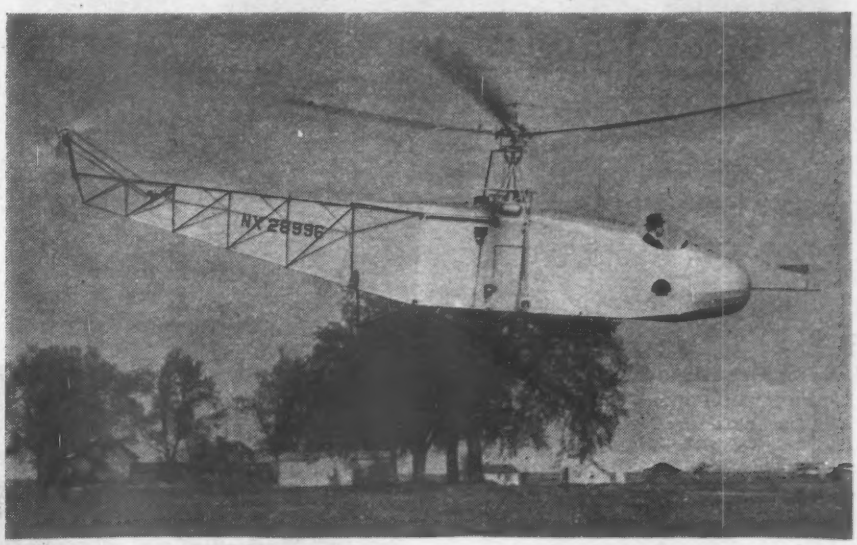
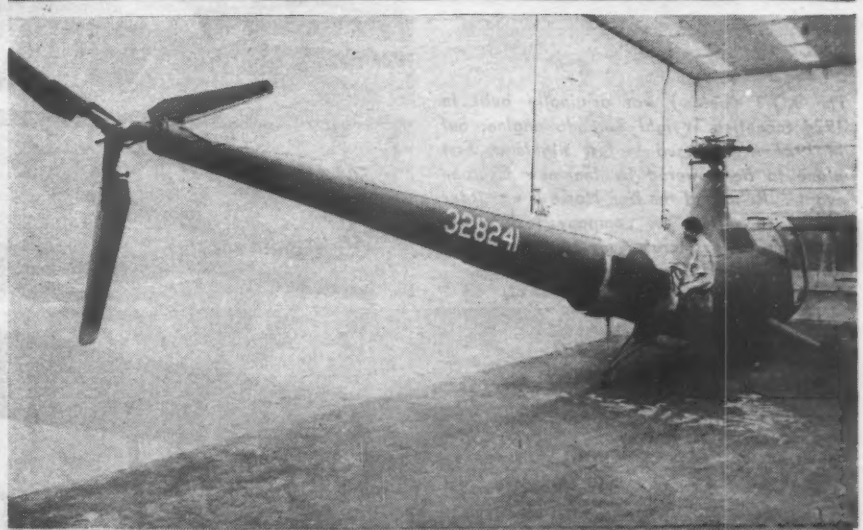
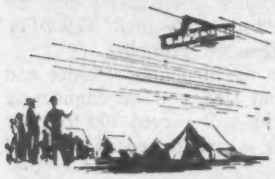


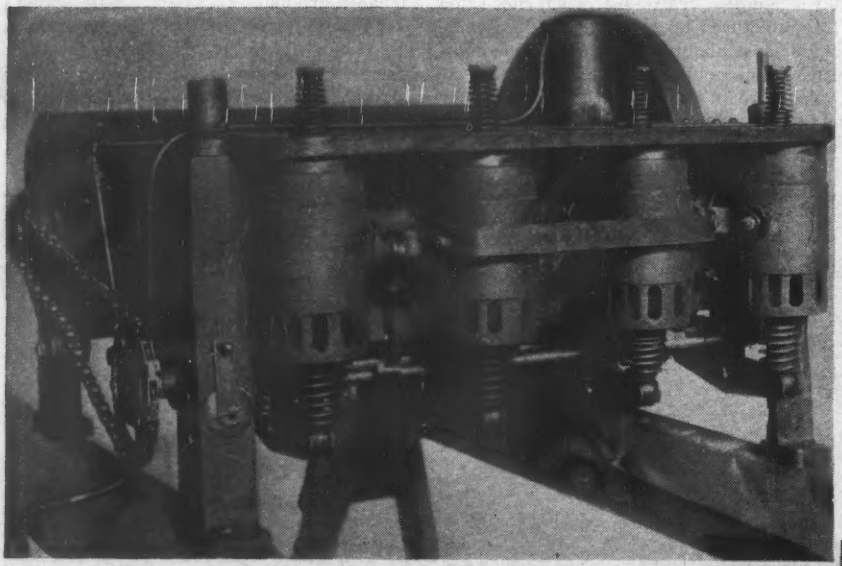


Striking advance in design within a comparatively short period is illustrated by these two contrasting shots. Top: Igor Sikorsky aloft in initial VS-300. Above: Designer's latest model, the XR-6, gets insignia paint job prior to installation of main rotor. "Helicopter research," says Mr. Morris, "is practically nil compared with the vast amount that has been done on the conventional airplanes. As the fund of knowledge grows, the entire outlook cannot but change accordingly."

WRIGHT AERONAUTICAL

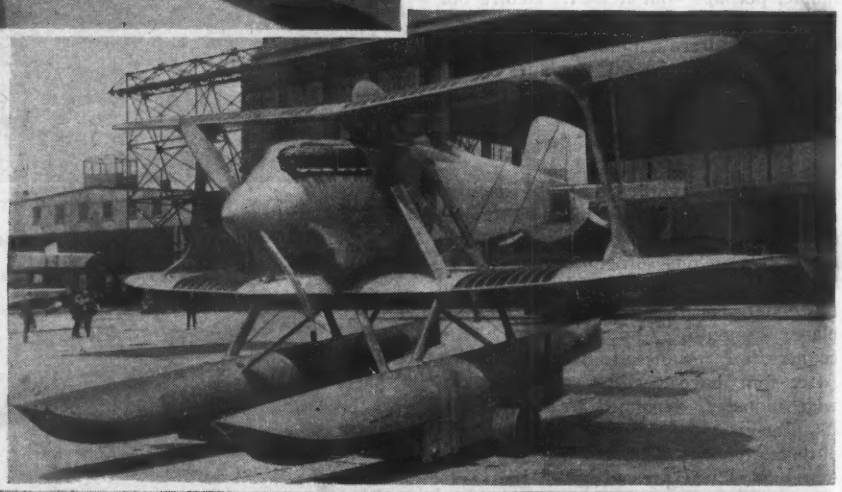


Producer of power plants for such craft as the Boeing Superfortress and Lockheed Constellation completes quarter-century of production. Striking industrial record includes design and construction of planes as well as engines. And jet plants are latest addition to program.



This is original Wright brothers engine designed and built in their own Dayton shop, which powered first flight at Kitty Hawk in 1903. Developing 12 hp., it weighed about 13 lb. per hp., in contrast to 25-30 lb. per hp. of automobile engines of that day, and 2,200 hp.—about 1 lb. per hp.—of present day Wright Cyclone 18's which power Boeing B-29 Superfortress and Lockheed Constellation.

Soon after Wright Aero entered field of airframe construction in 1922, it developed this NW-2 racer for Navy. With 675-hp. Wright Tornado engine it broke world's seaplane record at 186 mph. Slated for entry in Schneider Cup Race, it was kept from competing when broken prop blade ripped through pontoons to decommission plane.



The XO-3 (below) was originally built in 1924 mounting Wright Tornado engine, but in 1927 it was used in test flights as first plane to be powered by then-new Cyclone engine. Re-named the Iron Horse it was later placed in service as company test plane, being one of first craft ever used exclusively for research and development work.

Just how should aircraft parts and accessories be sold? Delving into that pertinent question, a successful aviation product manufacturing company which has its postwar plans complete declares there's—

A Place for the Distributor In Aircraft Accessory Sales

By **ARTHUR S. BROWN,** *Sales Manager, Scott Aviation Corp.*

THE AIRCRAFT INDUSTRY faces distribution problems which are perhaps more critical than any other industry has ever encountered. With a tremendous production capacity on the one hand, and practically no distribution organization on the other, the problem in any case would be difficult. But when the highly competitive post-war market conditions are added, the total job to be done begins to assume mountainous proportions.

The distributor of aircraft accessories and maintenance supplies is a necessary and important facility in this distribution system, provided his operations measure up to certain service standards. Just what are these requirements?

First, he must sell merchandise to retail outlets. The term "sell" here has a very broad connotation, for it includes many services to the retail outlet only indirectly associated with sales. He must, for example, help the retailer with his business organization, accounting practices, etc. He must see that the retailer maintains an adequate stock to assure good customer service. He must assist the retailer to obtain a rapid turn-over by suggesting display, sales promotion, and advertising programs, and by helping him to obtain orders through personal effort. And, finally, he must convince the retailer of the quality, usefulness, and profit possibilities of the merchandise he has in stock.

This is a continuing job. How can it best be accomplished? Let us consider each of the requirements listed above.

To sell merchandise, the distributor's salesman must himself be convinced of its quality, usefulness, and profit-making possibilities to the retailer. This means that the distributor should encourage the field assistance of manufacturers' representatives, the attendance of his men at sales meetings conducted by the manufacturer, and sales meetings of his own devoted to these purposes.

Obviously, no one man can remain continuously convinced of the merits of 1,000 or more products. So the distributor must segregate the products he handles into staple lines which produce profits through volume rather than discount spread, and also specialties which produce longer profits through discount spread. His salesmen should *sell* the specialty lines, opening each sales interview with such a specialty product. He should take orders for whatever staple items are need *only after selling the specialty.*

In this way time will be available for all products, and greatest results secured. Such a distributor's salesman can well be proud of his profession, for he is not only serving his customers by selling them useful merchandise, but he is also acting as their sales manager and business consultant as well.

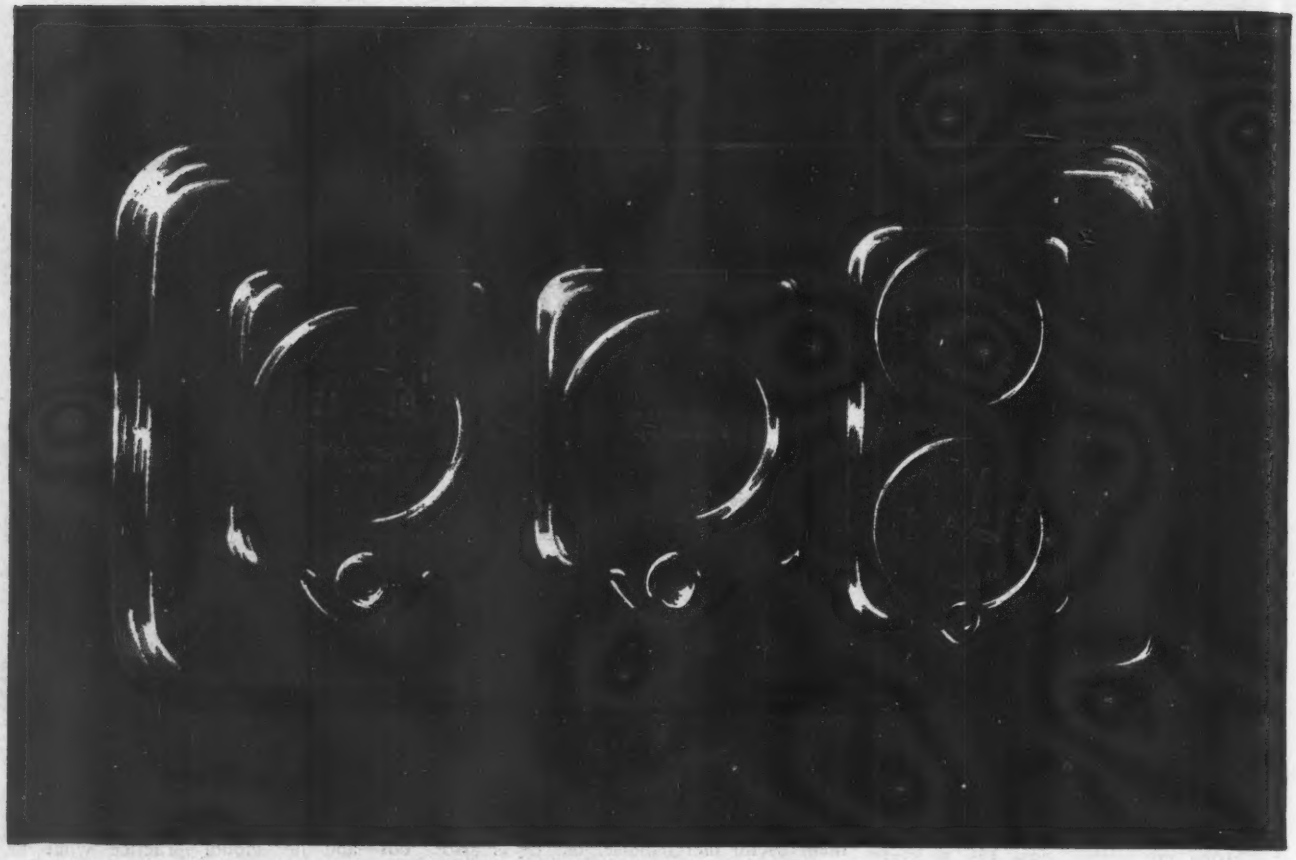
It is important that the distributor keep adequate stock in the retailer's establishment. He should remember here that what's sauce for the goose is sauce for the gander—by recommending a well-rounded stock of salable long-profit merchandise in a relatively few lines. The retailer should be able to rely on the distributor's prompt shipments for the staple items. Thus the retailer's money is only tied up in long-profit products.

The distributor's salesmen should be provided with sample accounting forms, inventory control forms, and similar material to aid the retailer in establishing correct business methods. Organized by the distributor, such material should be collated in a suitable manual so that the presentation is attractive and easy to use.

Finally, the distributor's salesman should be a student and teacher of correct advertising, display, and sales methods—and he should practice what he preaches. While many of the distributor's suppliers will provide helpful material, the final job is up to the salesman. For example, a wall poster can merely be handed to a retailer, or it can be used as an opportunity for discussion of correct location, merits of the product, and finally be given a preferred position.

(*Turn to page* 302)

"The distributor must help the retailer with his business organization, accounting, etc. . . and help him obtain rapid turnover by suggesting display, sales promotion, and advertising programs."



Four instruments are necessary for extended flying in restricted visibility, says Author Smith. They are compass-controlled (or "slaved") directional gyro; airspeed indicator; altimeter; and graphic-attitude indicator, a still-restricted but already-proven instrument.

What Kind of Instruments For the Personal Plane?*

By **FREDERICK H. SMITH,** *Sperry Gyroscope Co.*

Utility is a must if real plane markets are to be developed, and utility can be achieved only with proper instrumentation. Here are "specs" for three types of reasonably priced panels to give more hours of flying per dollar of investment.

THOSE OF US who are required to view tomorrow's light planes realistically are agreed unanimously, I think, on one extremely important proposition: That these planes must be designed, built, and equipped so that the men or women who buy them can derive some real utility—aside from the fun of flying—from their purchases.

Ways must be found to afford the buyer more hours-per-year of business- and pleasure-flying per dollar of investment in his light plane. If this is not done we will have turned our enthusiasts into dissatisfied customers, and customers who are dissatisfied are just as deadly to the aircraft business as to any other.

We must make the light plane not only a convenience, but a necessity; we must make it so handy, so dependable, and so easily available in terms of everyday transportation that people will look forward to its regular use. The light plane must become a *utility*.

We who manufacture instruments are not directly concerned with the problems of moderate hangar-rent, low cost spare parts, or the numbers and accessibility of airports. The question of adequate airworthy maintenance for the customer's airplane is not one of *immediate* concern, either, though all of these items are certainly vital to every one who has a commercial stake in the welfare of the light plane industry. These are problems that must be solved in a very sensible manner, again in the name of convenience and utility.

To be realistic about instrumentation for the light plane, however, is "right up our alley". We know that the airman who flies in Florida, New Mexico, and Arizona needs but few instruments in his plane to get real utility from it, because his weather is almost perpetually contact. We also know that the fellow who lives on Cape Cod, Long Island, or in Cleveland or Chicago will at least require the basic instruments so that he'll know his speed, altitude, and direction—

*Based on a paper presented before the Institute of Aeronautical Sciences National Light Aircraft Meeting.

if he's to get the useful flying time from his plane that he has paid for and is entitled to receive. The man who flies out of Pittsburgh or Birmingham can make up his mind at the outset to buy a complete set of instruments if he ever wants to see the sun. We also expect to get some regular customers in Newark and Philadelphia, too.

It is a fact that, in most sections of the United States, the number of flying days available to the light plane owner appears to be almost directly in proportion to the amount of flight instrumentation installed in his aircraft. For example, weather averages over a period of years show that each year in New England one can expect about 180 days of weather that could be classed as contact, 96 days wherein visibility is restricted, and the remainder definitely doubtful so far as itinerant flying is concerned.

Now if a man owns a plane equipped only for contact flight he has but half the year in which to use his airplane. If he wants to fly during the 30 percent of the year when his weather is neither contact or doubtful, it requires, strangely enough, just about an additional 30 percent investment in flight instruments and radio equipment for him to do so safely and legally.

This rough percentage-of-investment formula, used loosely here, does not apply when the aircraft is heavy, but it does apply to the light plane. It is, then, safe to say this: In light planes, the percentage of added utility afforded by flight instrumentation will increase almost exactly as the cost of this instrumentation, computed as a percentage of the list price of the un-instrumented airplane.

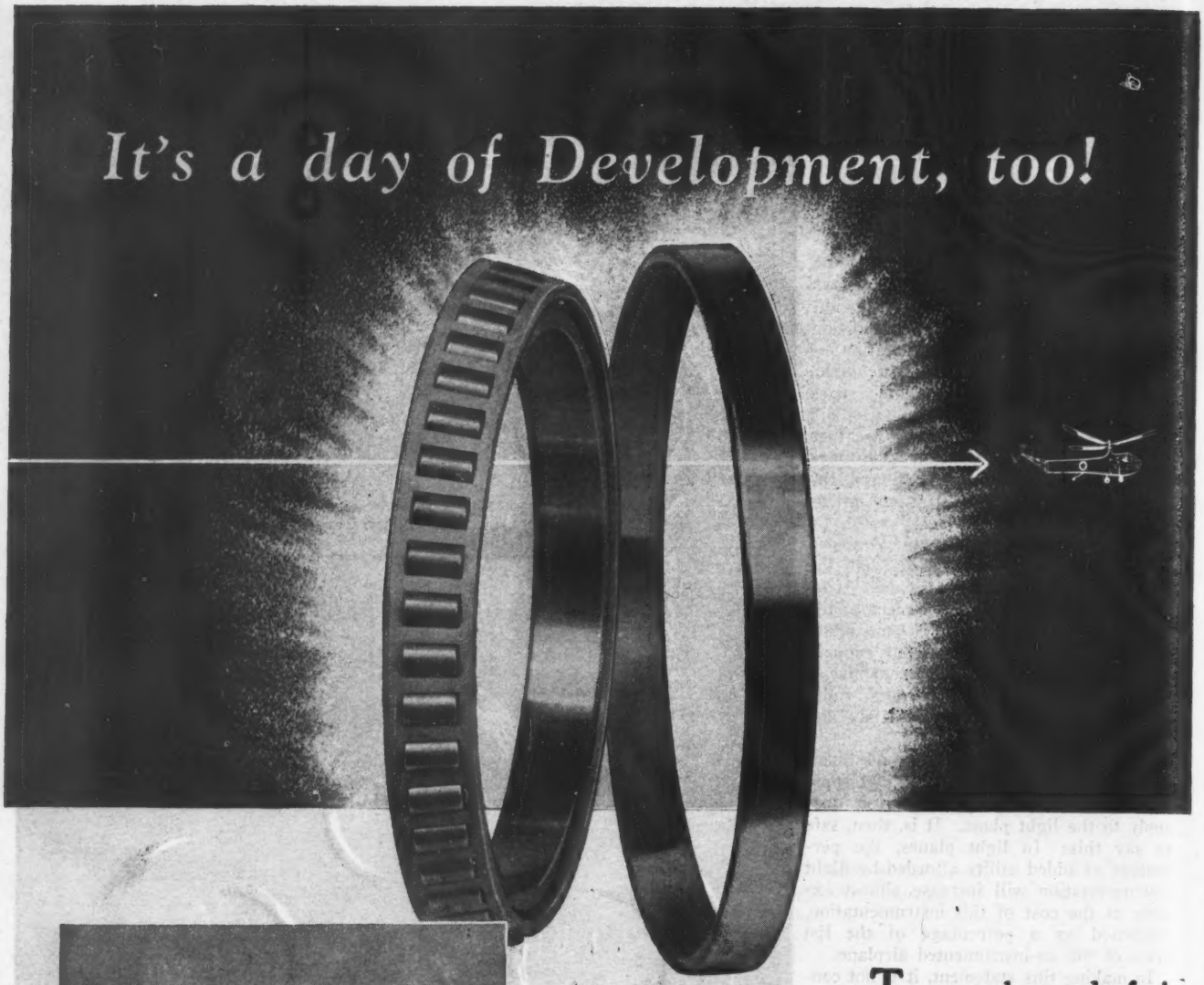
In making this statement, it is not contemplated that the average light plane pilot will care to fly instrument weather as it is presently known and classified in Civil Aeronautics Regulations. The instruments provided will be capable of doing the job *if the airman concerned is qualified to use them for extended, true instrument flight;* but their real purpose, defined in terms of light plane utility, would be to allow the safe and legal use of the light plane when local smoke, haze, etc., restrict visibility locally. (In this connection it is felt that the Civil Aeronautics Board should include another flight-classification in its rules, covering such weather conditions; it could be called Extended Contact Flight or "XCFR".)

The added utility a light plane pilot

(*Turn to page* 305)

Three types of personal planes are foreseen by author, each requiring different instruments. "Cave" plane — tomorrow's Model T—will need only airspeed, altimeter, and compass, in addition to engine instruments, as shown at left. "Utility" craft, with wider range, should have airspeed, compass, directional gyro, and altitude indicator, as portrayed in center. Third type, or "heavy," should have all instruments of utility craft plus automatic pilot equipped with "slaved" directional gyro, as shown at right.

It's a day of Development, too!



** A Sikorsky XR-4 hovering motionless over East Hartford, Connecticut. This first helicopter to be delivered to the Army Air Forces is equipped with six Timken Bearings in the Main Rotor Blade, two in the Tail Rotor Gear Box, and six in the wheels.*

To meet the need of aircraft engineers for an anti-friction bearing — lighter in weight — of compact design — with maximum radial and thrust load carrying capacity — Timken engineers have developed a new series of tapered roller bearings.

Already, these bearings have contributed to the fine performance of Sikorsky helicopters . . . while giving them all the other advantages of Timken Bearing design for aircraft applications: assured smoothness of operation . . . ease of handling . . . power conservation and endurance . . . economical maintenance.

Consult us on your requirements. We will be glad to make recommendations.

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

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TAPERED ROLLER BEARINGS

Bell helicopter shown here is representative type of single-rotor craft with anti-torque propeller (illustrated in three views of Fig. 4).

BASIC DRIVES FOR HELICOPTERS

By **JOSEPH S. PECKER,** *Chairman of the Board, RotaWings, Inc.*

Presented here is a simple and effective introduction to the timely subject of helicopters. Beginning with the roadable autogiro—the transitional design between automobile and 'copter—the various arrangements and functions of basic transmission units in single-rotor, bi-axial, and co-axial rotor craft are clearly analyzed.*

TO FULLY UNDERSTAND the mechanical elements of a helicopter—the transmissions, hubs, swashplate, anti-torque propeller, and control, it is necessary to become familiar with the maneuvers and flight characteristics of the craft and understand the need to reduce control to its simplest form in order to facilitate handling by a non-expert pilot.

The mechanism of the present-day helicopter closely resembles the mechanical arrangement in an automobile. Comparatively, the outstanding variations in the mechanism of a helicopter are simply to attain maneuverability essential to a flying machine.

In connection with the discussion of the various mechanical apparatus, it would be well to list various end results required in the operation of a helicopter:

1. The power from the engine must be transmitted to the rotor, and in transmitting this power it must pass through (a) a clutch for accelerating the rotor from rest, and (b) a gear speed reduction unit.

2. Some of the power must also be directed to the anti-torque propeller or propellers also utilized for directional control.

3. Mechanism must be provided for control of vertical flight both in raising and lowering the craft as well as for control in forward, sidewise, and rearward flight.

Fig. 1 shows the general arrangement of a type of helicopter incorporating a single rotor and an anti-torque propeller. An examination of the transmission elements indicates an arrangement very similar to that of an automobile, as shown in Fig. 2. The transitional design between

* This article is from material which will appear in a forthcoming book by Joseph S. Pecker and Agnew E. Larsen, to be published by the McGraw-Hill Book Co.

Platt-LePage bi-axial type helicopter with rotors laterally disposed. No anti-torque propeller is utilized. (Three-view aspects of this type craft are illustrated in Fig. 5.)

the elements of automobile and helicopter is illustrated in Fig. 3, which represents the first model roadable autogiro designed in 1935 by Agnew E. Larsen for the Autogiro Co. of America.

In the helicopter elements shown in Fig. 1, (A) is the power plant, (B) the transmission, including the clutch, (C) the vertical drive shaft to the rotor, (D) the drive to the anti-torque propeller, (E) the cooling fan, (F) the hub, and (G) the swashplate for the pitch control of the blades.

Many forms of helicopters have been built and tested, but the three most popularly known today, are:

1. A single-rotor type with single anti-torque propeller (as built by Sikorsky, Young (Bell), Piasecki, Higgins, and Kaiser.

2. The bi-axial type, laterally disposed (Focke, Breguet, Pateras-Pescara, Perry, Crocker-Hewett, and Platt-LePage).

3. The co-axial type (De Bothezat, and Hiller).

These helicopters are diagrammatically illustrated in Figs. 4, 5, and 6. **Fig. 7** shows a bi-axial type with rotors longitudinally disposed. It will be noted that in the bi-axial and co-axial types, the anti-torque propeller is eliminated.

We will first consider the single-rotor type (Fig. 4) and analyze the required functions of the various elements of the transmission. The same considerations would be applicable to the other types, with slight variations discussed later.

Speed Reduction

Roto designs vary in diameter, chord, pitch, etc., for specific sizes and weights of helicopters. For purposes of this discussion, we may assume an average rotor speed of approximately 200 rpm. and a nominal engine speed of 2,000 rpm. It is evident, then, that a speed reduction gear must be provided having a ratio of approximately 10:1.

Starting Clutch

A familiar application of a clutch is in acceleration of an automobile from rest to a required speed. An experienced operator balances acceleration of engine

Sikorsky XR-5, like Bell helicopter, is also representative of single-rotor craft (diagrammatically shown in Fig. 4).

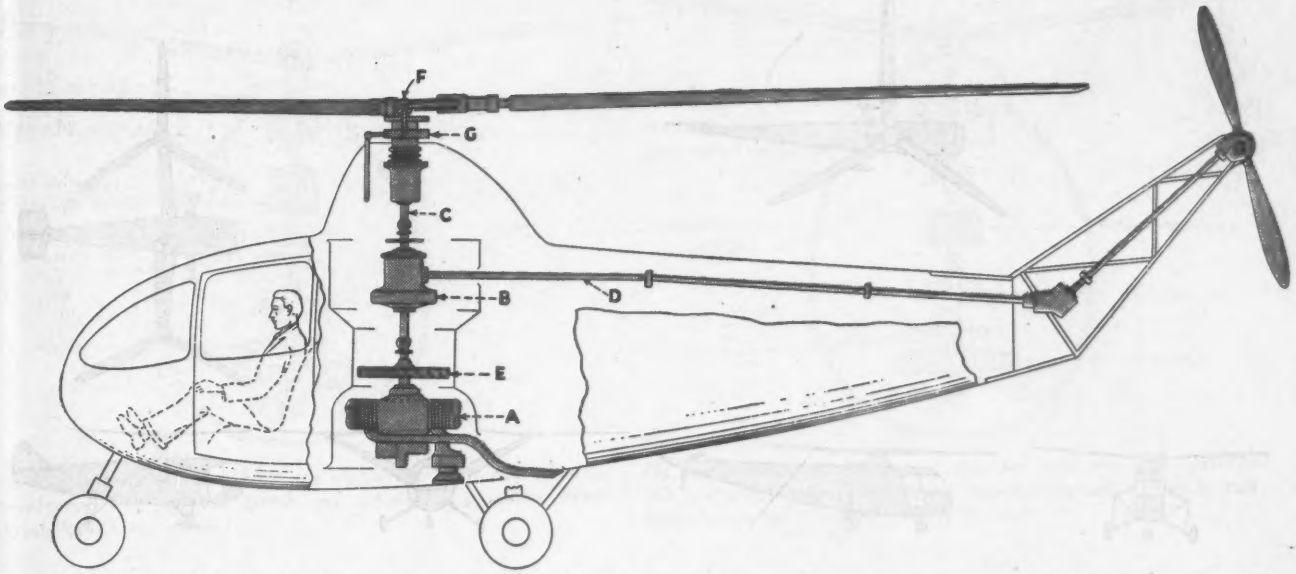


Fig. 1. Typical arrangement of units in single-rotor type helicopter as built by Sikorsky, Young (Bell), Piasecki, Kaiser, and Higgins. (A) shows engine; (B) transmission, including clutch; (C) vertical drive shaft to rotor; (D) drive to anti-torque propeller; (E) cooling fan; (F) hub; and (G) swashplate for blade pitch control.

speed against operation of the clutch pedal to obtain smooth pickup. This is done by "feel".

Actually, the operator learns to balance the required torque in accelerating the load by gaging the amount of clutch pick-up and engine speed. This method has been utilized for many years in accelerating autogiros. Later it was found desirable to bring the engine up to prescribed speed and apply pressure on the clutch plates through a timing device which would accelerate a 35-ft. rotor in approximately 20 to 90 sec. This resulted in smooth, safe rotor acceleration.

Following, again, the analogy of an automobile, we find several gear speed changes to facilitate acceleration from zero to cruising speed. In a helicopter, variable speed reduction ratios have as yet not been adopted. Attempts have been made to secure a device for acceleration of the rotor system from zero to maximum speed through a simple automatic device. It may well be that pioneering in helicopters will provide the gearless transmission so desired in the automotive industry.

To appreciate the problems attendant with a clutch or starting mechanism to meet the characteristics involved in starting a helicopter rotor, the following requirements are listed:

1. It should be possible to rev the engine freely without engaging the drive to the rotor.
2. Power must be applied gradually and uniformly by limiting the torque, either through variable ratio transmission, step ratios, friction clutches, or a combination of all.
3. The semi-flexible structure of the helicopter body framework and the rotor, including the mechanism by which the rotor blades are attached to the hub, must not be unduly strained.
4. Safety means must be provided to reduce any tendency toward over-throttling or (when the rotor is at speed)

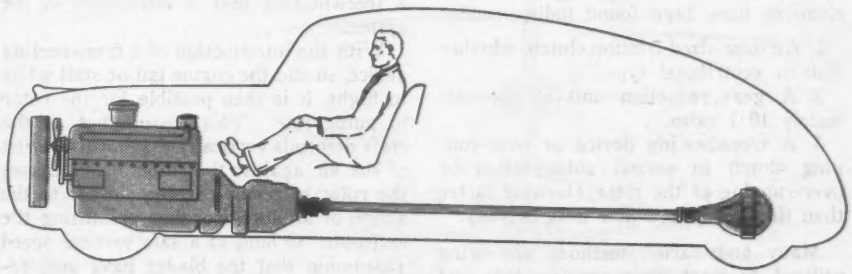


Fig. 2. Typical arrangement of automobile units, showing relative positions of engine, transmission, and universal drive to rear wheels. By considering this arrangement in vertical position and comparing it with helicopter illustrated in Fig. 1, similarity of mechanical drives is apparent.

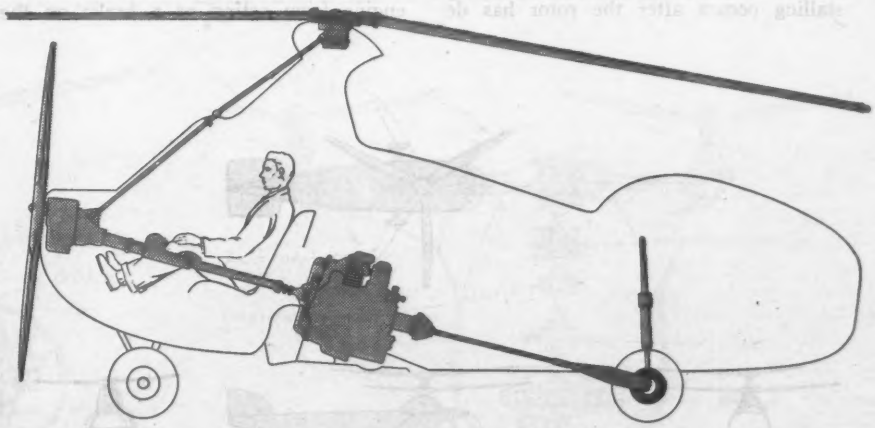


Fig. 3. Diagrammatic sketch of first roadable autogiro, designed by Agnew E. Larsen in 1935 for Autogiro Co. of America, shows transitional design between typical transmission elements of automobile (Fig. 2) and present-day helicopter (Fig. 1). Features of roadable autogiro were Pobjoy engine buried in body of fuselage, drive to rear wheels for road transportation, and drive to rotor for bringing latter up to speed.

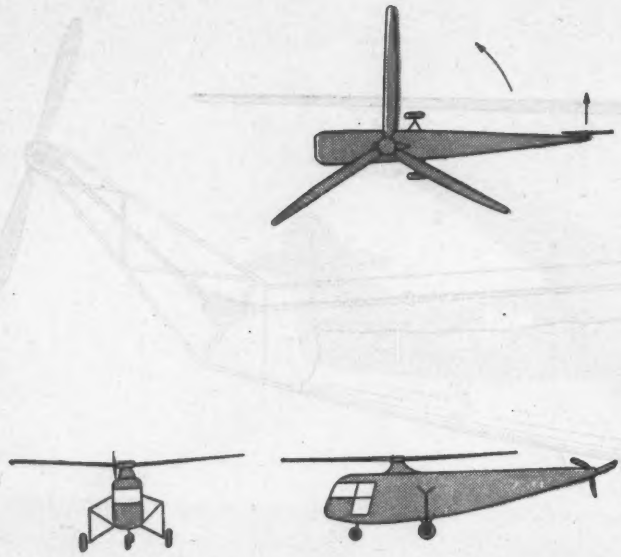


Fig. 4. Three-view illustration of single-rotor helicopter with anti-torque propeller, typical of Sikorsky, Young (Bell), Piasecki, Kaiser, and Higgins designs.

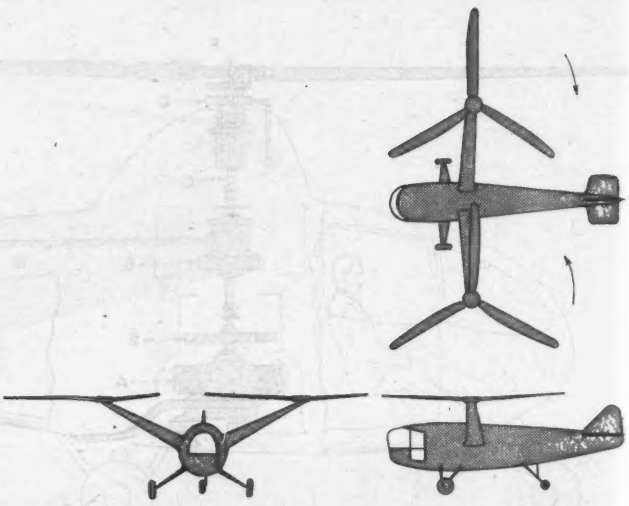


Fig. 5. Bi-axial type helicopter with rotors laterally disposed, as built by Focke in Germany and Platt-LePage in United States, is shown here in three view aspect.

under-throttling, without fear of stalling the engine.

To accomplish the foregoing, three basic elements have been found indispensable:

1. An over-sized friction clutch, whether disk or centrifugal type.
2. A gear reduction unit of approximately 10:1 ratio.
3. A freewheeling device or over-running clutch to permit autogyration or over-running of the rotor (turning faster than the speed at which it is driven).

Many and varied methods are being utilized to meet these requirements and some of the more practical will be discussed.

Freewheeling

If an automobile engine stalls because of poor acceleration, the automobile remains stalled. But in a helicopter, if engine stalling occurs after the rotor has developed some speed, the kinetic energy of the rotor would tend to drive the engine, which is undesirable. To overcome this, a freewheeling unit is introduced in the system.

With the introduction of a freewheeling device, should the engine fail or stall while in flight, it is then possible for the rotor to autogyrate. This means that as the craft descends vertically the upward thrust of the air against the rotor blades causes the rotor to revolve freely, similar to the action of an autogiro, thus permitting the helicopter to land at a safe vertical speed (assuming that the blades have auto-rotational means set either by the pilot, or automatically, to a rotational angle).

Another function of freewheeling is the ability of the rotor to continue spinning, should the engine be throttled, purposely or inadvertantly, below the gear speed ratio of the transmission. The introduction of freewheeling also prevents the engine from acting as a brake on the rotor, so insuring safety of the helicopter.

Anti-Torque

A drive must be provided to the anti-torque propeller and the latter must be geared to and operated with the main rotor at all times. The stability and maneuverability of the helicopter is dependent on the synchronization of both rotors. This is true whether the helicopter is in flight under power, or whether the engine is stalled and the helicopter is being landed under autogyration.

Relative Arrangement of Transmission Elements

The arrangement of the clutch, speed reduction unit, freewheeling unit, and gear drive to the anti-torque propeller, and the position of the engine may be varied at the discretion of the designer. Some fundamental principles, however, must be considered and adhered to. Figs. 8, 9, and

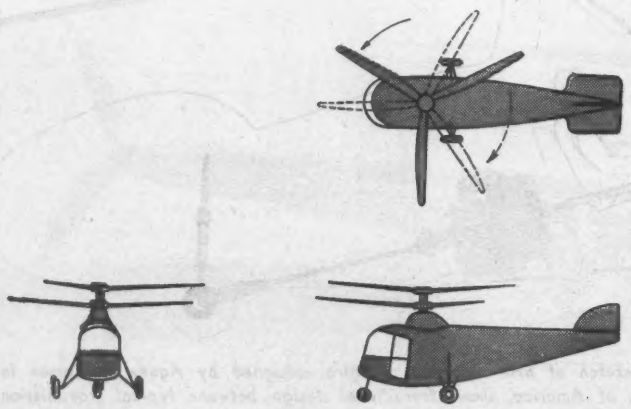


Fig. 6. Co-axial type helicopter as constructed by De Bothezat, and by Hiller. Anti-torque propeller is eliminated.

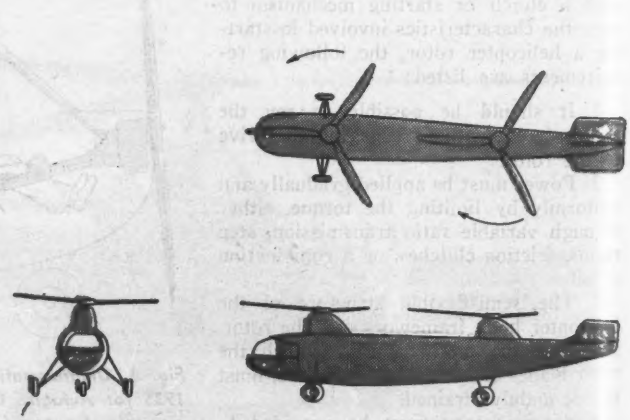


Fig. 7. Bi-axial type craft shown here has rotors longitudinally disposed, in contrast with rotors shown in Fig. 5.

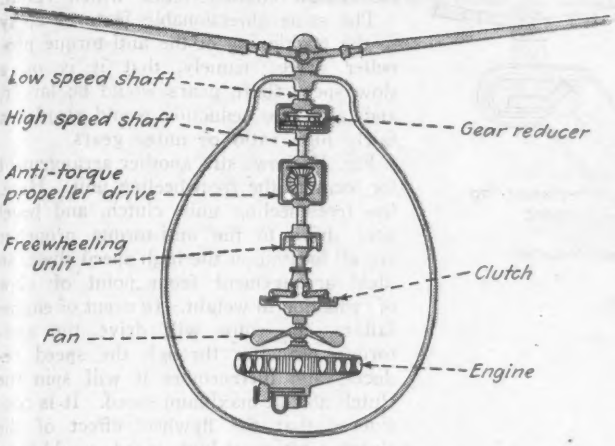


Fig. 8. One form of transmission for single-rotor helicopter showing freewheeling unit between clutch and anti-torque propeller drive. (Swashplate is not shown.)

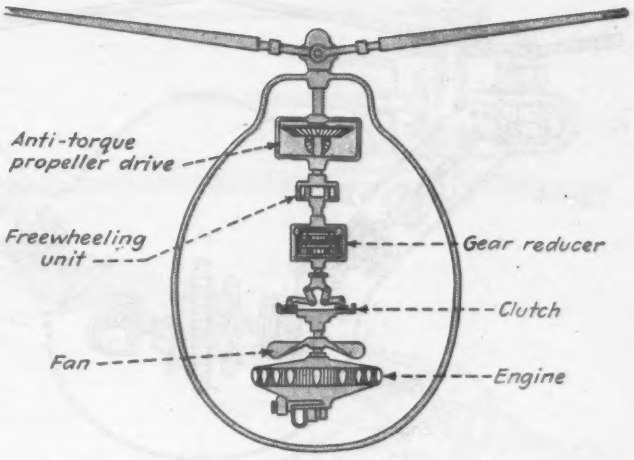


Fig. 9. Transmission arrangement depicted here has gear reduction unit interposed between clutch and freewheeling unit. Drive to anti-torque propeller is geared directly to rotor.

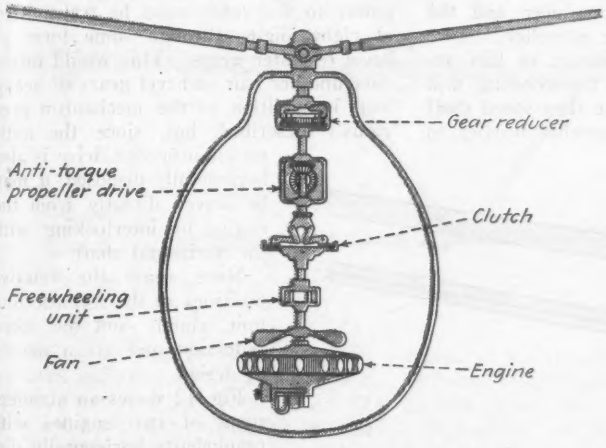


Fig. 10. Freewheeling unit is positioned here between engine and clutch. Freewheeling unit, clutch, and bevel gear drive to anti-torque propeller are all located on high-speed shaft.

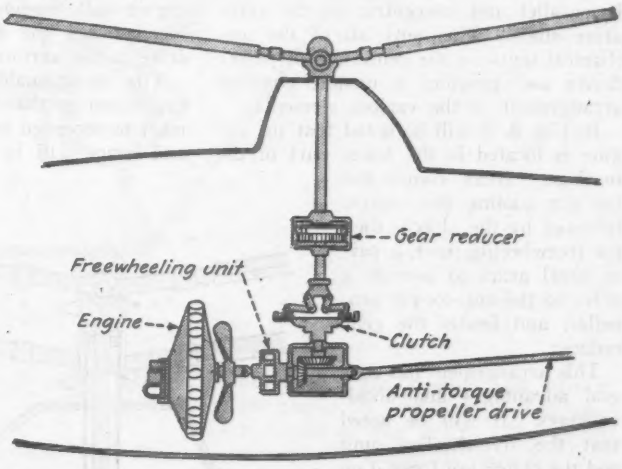


Fig. 11. Engine crankshaft is shown horizontally disposed, and anti-torque propeller drive is between freewheeling unit and clutch. Arrangement is not considered practical.

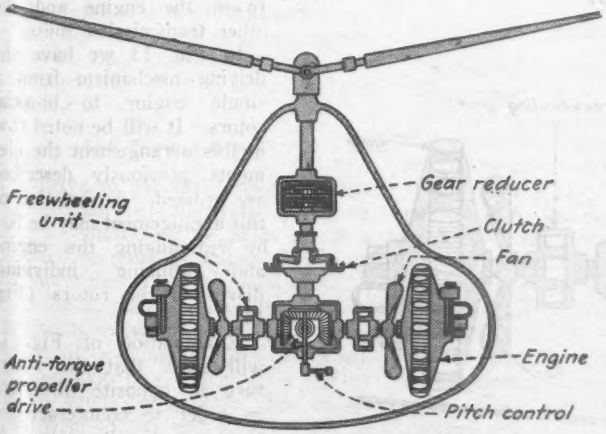


Fig. 12. Depicted are two engines with crankshafts horizontal. Freewheeling unit is between engine and other transmission units.

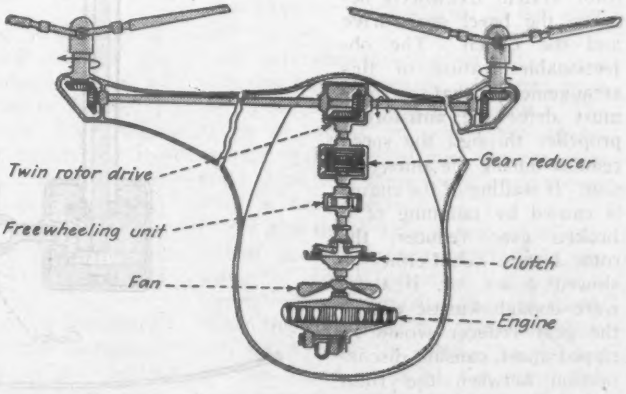


Fig. 13. Shown here is driving mechanism from single engine to bi-axial rotors, a typical arrangement for this type helicopter.

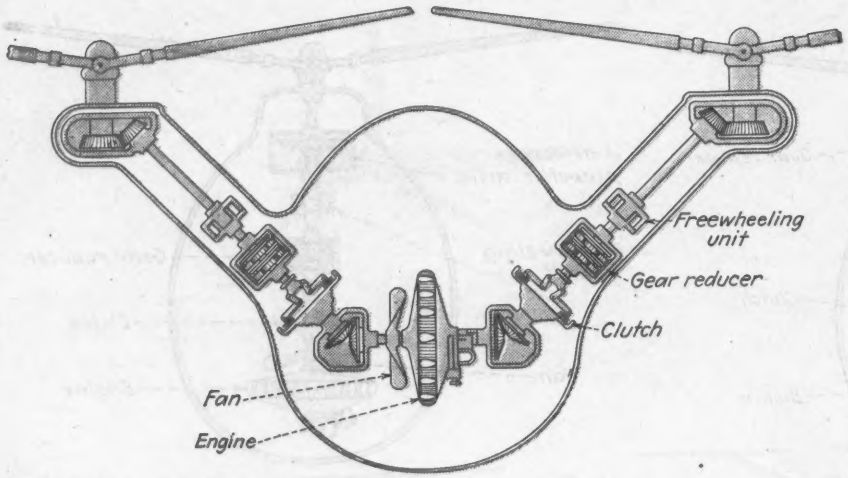


Fig. 14. Another basic arrangement for bi-axial transmission with use of single engine. (It is advisable that both clutches be simultaneously applied).

10 show three arrangements wherein the engine is mounted so that the crankshaft is parallel and concentric to the rotor drive shaft. This puts all of the mechanical units on the centerline of power drives and provides a unique, compact arrangement of the various elements.

In Fig. 8, it will be noted that the engine is located in the lower part of the fuselage. Next comes the fan for cooling the engine, followed by the clutch, then the freewheeling unit, a pair of bevel gears to provide a drive to the anti-torque propeller, and finally the gear reducer.

This arrangement has several advantages and disadvantages. It will be noted that the freewheeling unit and the clutch are located on the high-speed shaft. This is good design and reduces the weight of the parts.

It is also to be noted that in event of reduction gear failure, the anti-torque propeller and the rotor are still geared together, although the rotor system freewheels between the bevel gear drive and the clutch. The objectionable feature of this arrangement is that the rotor must drive the anti-torque propeller through the speed reducer during the autogyration. If stalling of the engine is caused by jamming of a broken gear reducer, the rotor system would either be slowed down, or, if there were enough kinetic energy the gear reducer would be ripped apart, causing disconnection between the rotor and anti-torque propeller.

Obviously, then, an arrangement as shown in Fig. 9 would tie together the rotor and the anti-torque propeller, and should the engine stall, freewheeling would be possible between the gear reducer and the drive to the anti-torque propeller.

The objectionable feature to this arrangement is that the freewheeling unit must be mounted on the slow-speed shaft and hence will be somewhat heavier in the design characteristics which result.

The same objectionable features apply to the positioning of the anti-torque propeller drive; namely, that it is on a slow speed shaft, gears would be larger, and, also, the reduction would require a fairly high ratio of miter gears.

Fig. 10 shows still another arrangement for locating the freewheeling unit. Here, the freewheeling unit, clutch, and bevel gear drive to the anti-torque propeller are all located on the high-speed shaft, an ideal arrangement from point of view of reduction in weight. In event of engine failure, the rotor will drive the anti-torque propeller through the speed reducer, and furthermore it will spin the clutch unit at maximum speed. It is considered that the flywheel effect of the clutch rotating at high speed, would have a beneficial effect rather than a tendency to dissipate the energy in the rotor.

Fig. 11 shows an arrangement in which the engine is located with the crankshaft in a horizontal position, which may be termed standard or conventional. As the rotor drive shaft is, of necessity, disposed on the vertical axis, it is apparent that the power to the rotor must be transmitted at right angles through some form of bevel or miter gears. This would introduce another pair of bevel gears of heavy load in addition to the mechanism previously described, but, since the anti-torque propeller drive is also horizontally disposed, it may be driven directly from the engine by interlocking with the horizontal shaft.

Here again the relative positions of the freewheeling unit, clutch, and the speed reduction unit are a matter of design.

Fig. 12 shows an arrangement of two engines with crankshafts horizontally disposed. This illustrates a means of imparting combined power of two engines to the rotor and whereby one engine may continue to drive if the other fails. The freewheeling unit is located between the engine and the other transmission units.

In Fig. 13 we have the driving mechanism from a single engine to bi-axial rotors. It will be noted that in this arrangement the elements previously described are utilized. A variation of this arrangement may be had by rearranging the engine and utilizing individual drives to the rotors (Fig. 14).

Examination of Fig. 13 will show that the rotors turn in opposite directions in order to counteract the torque. Furthermore, in event of engine failure, the one freewheeling unit allows

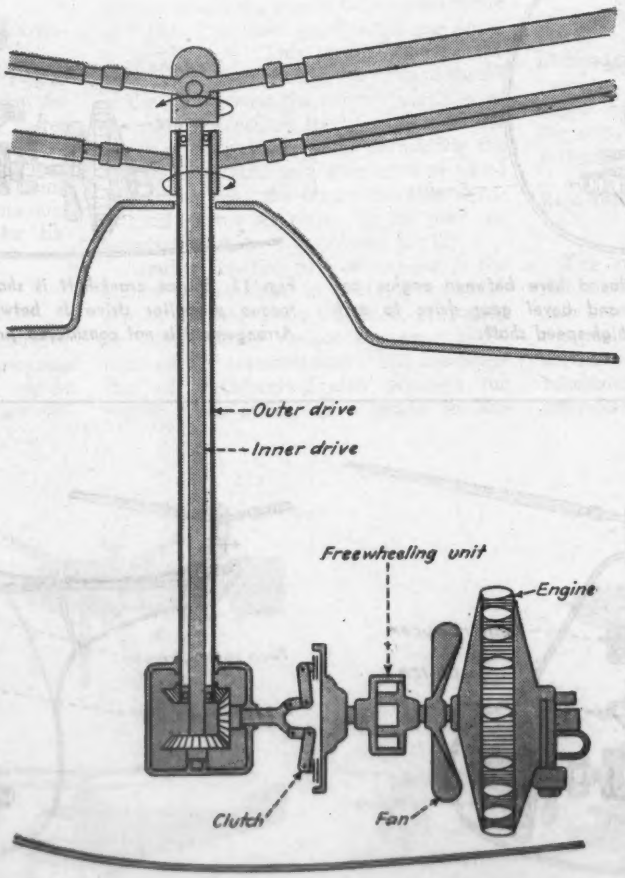


Fig. 15. Typical arrangement for driving co-axial rotors, with engine crankshaft horizontally disposed.

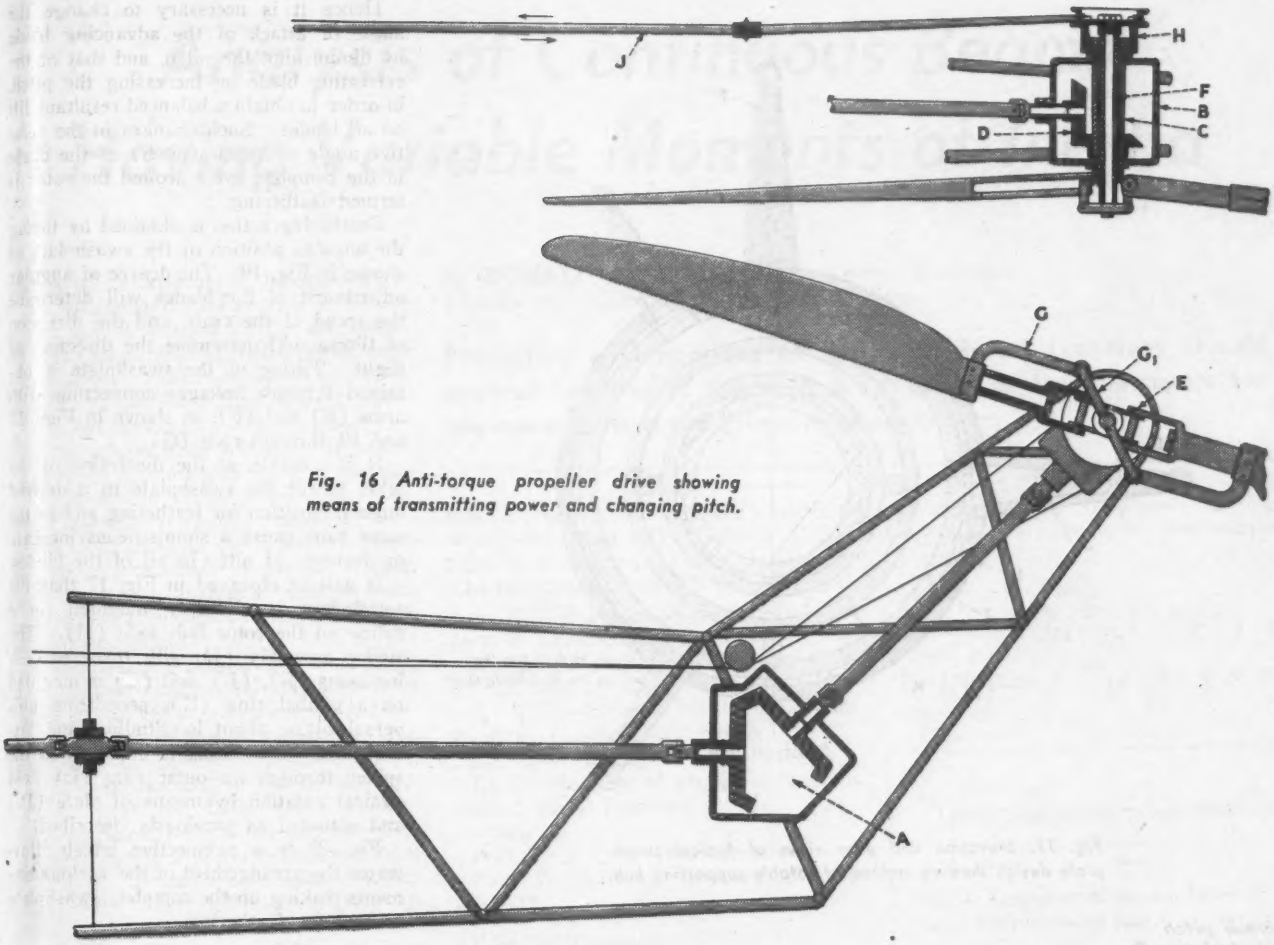


Fig. 16 Anti-torque propeller drive showing means of transmitting power and changing pitch.

both rotors to turn in synchronization. One speed reduction unit and one friction clutch are used for both rotors. Figs. 13 and 14 are basic in principle, for bi-axial drive. Variations in detail design are many, and may be applied by a rearrangement of the several elements previously described.

Fig. 15 illustrates a typical arrangement for driving co-axial rotors. Obviously, the engine could be located either on the forward side of the craft, as shown, or could be disposed with the crankshaft vertical as illustrated in other arrangements. The freewheeling unit and the clutch may be arranged as shown, or in reverse positions.

Anti-Torque Drive

The drive to the anti-torque propeller and its mechanism is illustrated in Fig. 16. The drive shaft may be made up of a number of sections as shown in Fig. 1, and where the angle becomes acute, a pair of bevel gears is introduced as at (A), Fig. 16. Fastened to the end of the airframe is a housing (B) in which rotates an axle (C), driven by a pair of bevel or miter gears (D). The blades are fastened to the end of axle (C) at hinge centers (E), and pitch is changed through the rod (F) and links (G) by means of the threaded cable wheel (H), operated by the cable (J) leading to the cockpit of the ship.

A study of this arrangement will indicate that the operation of the cables (J) will turn wheel (H) which is threaded movably on housing (B) and will move shaft (F) horizontally. Links (G) and (G_1) will cause the blades to change pitch. The same arrangement would be applicable if three anti-torque propeller blades were used.

Swashplate

Referring again to Fig. 1, we note an arrangement (G) located close to the rotor system and commonly referred to as the swashplate (space cam or feathering control mechanism), more fully illustrated in Fig. 17. To understand the purpose of the swashplate, it would be well to discuss basic principles both in vertical and directional flight, as exemplified by such helicopters as built by Sikorsky, Young (Bell), Piasecki, RotaWings, and others.

In vertical flight, upward or downward, a helicopter is dependent upon change of pitch (angle of attack) of the blades (lifting screw). In vertical flight, each blade supports an equal amount of load; therefore, a uniform increase or decrease in the blade angle or pitch will govern the amount of lift, and hence, the up and down travel of the craft. The speed or rate of lift change is naturally dependent on proper throttling or regulation of the engine speed.

Referring to Figs. 17 and 18, a pull of the rod (A) in the direction indicated would move sleeve (B) vertically in the direction shown at (C), and vertical rods (D) fastened to levers (D_1), (D_2), and (D_3) would also move vertically and cause turning of all three blades on their span axes for pitch change in the same direction.

By reversing the push on rod (A), a variation in pitch can be subtracted from all three blades simultaneously. The range of angles, in which the blades operate with aerodynamic efficiency, are quite small, and therefore a great movement is not necessary.

For directional flight a new set of conditions occur. In horizontal flight the actual or virtual plane of the rotor is tipped in the direction of desired flight. When tipped forward, the advancing blade will travel faster, in relation to the air, by the added speed of the craft and, conversely, the retreating blade will have a diminished speed in relation to the air.

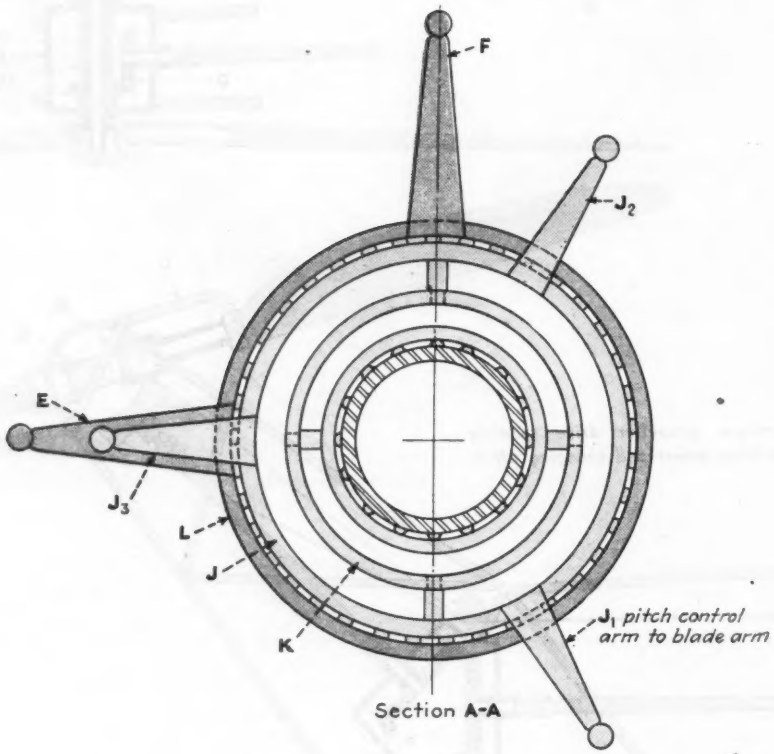
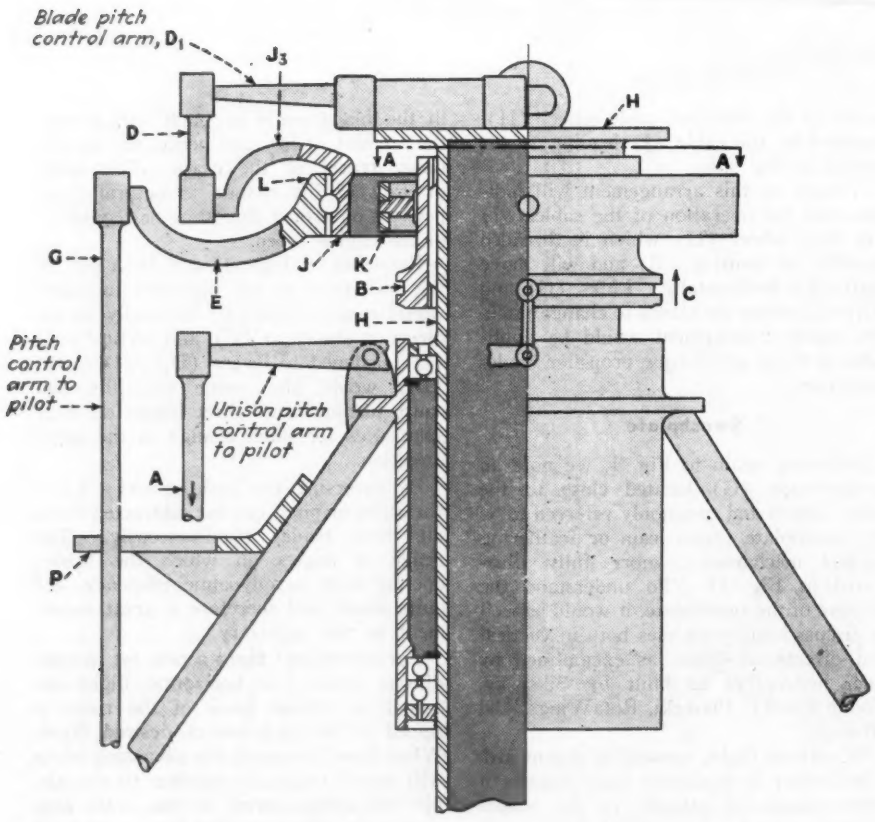


Fig. 17. Elevation and plan views of typical swashplate design showing method of rotably supporting hub.



Hence it is necessary to change the angle of attack of the advancing blade by diminishing the pitch, and that of the retreating blade by increasing the pitch, in order to obtain a balanced resultant lift on all blades. Such changes in the relative angle of attack (pitch) of the blade in the complete cycle around the rotor is termed feathering.

Feathering action is obtained by tilting the angular position of the swashplate as shown in Fig. 19. The degree of angular adjustment of the blades will determine the speed of the craft, and the direction of tilting will determine the direction of flight. Tilting of the swashplate is obtained through linkages connecting with arms (E) and (F), as shown in Figs. 17 and 19, through rods (G).

It is possible, at the discretion of the pilot, to tilt the swashplate to a desired angular position for feathering and at the same time cause a simultaneous increase or decrease of pitch in all of the blades.

It will be observed in Fig. 17 that the swashplate is slideably mounted on a spline on the rotor hub axle (H). The spider assembly (J) with three extending arms (J_1), (J_2), and (J_3) is mounted on a gimbal ring (K), permitting universal tilting about longitudinal and lateral axes. The tilting is imparted to the spider through an outer ring (L) held against rotation by means of plate (P), and actuated as previously described.

Fig. 20 is a perspective which illustrates the arrangement of the various elements making up the complete swashplate control for feathering.

Summary

We have discussed, in an elementary manner, the powerplant method of transmitting power, the anti-torque propeller mechanism, the swashplate, and the method for controlling pitch and feathering of the rotor blades.

Summarizing, it is apparent that sound engineering must be directed toward the attainment of: (1) An efficient drive, (2) minimum weight of parts, (3) rigidity in mounting to insure full life of bearings, (4) reduction of transmission noises, (5) proper cooling of engine and transmission, (6) ease of assembly, operation, and maintenance, and (7) safety of the helicopter in all conditions of flight.

Experience has indicated the desirability of a transmission arrangement whereby the various elements may be removed independently of each other. For example, a transmission including the gear reducer, clutch, and freewheeling unit, could be built for removal as an integral unit, as shown in Fig. 1. The engine could also be removed as a separate unit. Likewise, the hub and the rotor system could be independently removable.

The engine transmission unit and the hub could be interconnected with universal joints to obviate the need of assembling the units in perfect alignment. This would also provide smooth operation, should the airframe tend to flex under various loads.

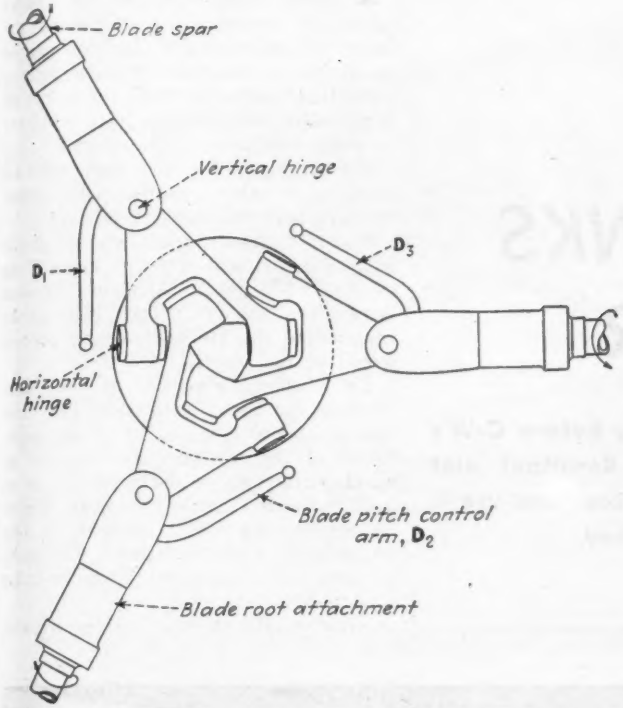


Fig. 18. Plan view of swashplate arrangement illustrating rotor blade attachments and levers for pitch control and feathering.

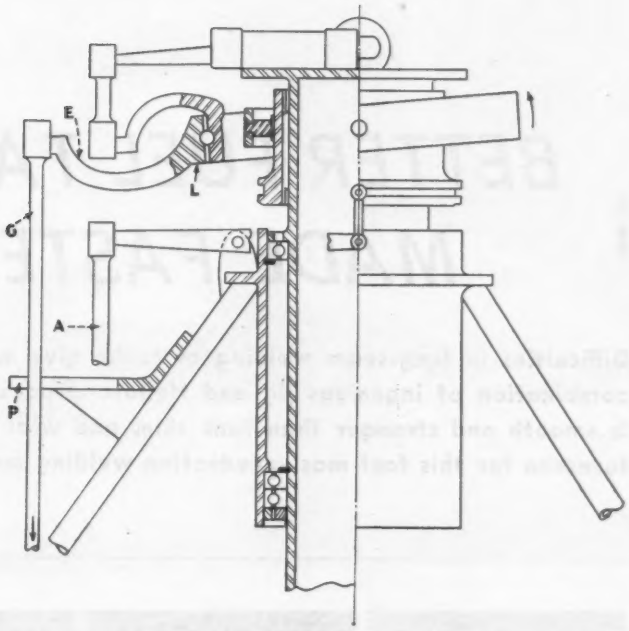


Fig. 19. Illustrated here is swashplate similar to that shown in Fig. 17, but tilted to show swashplate action.

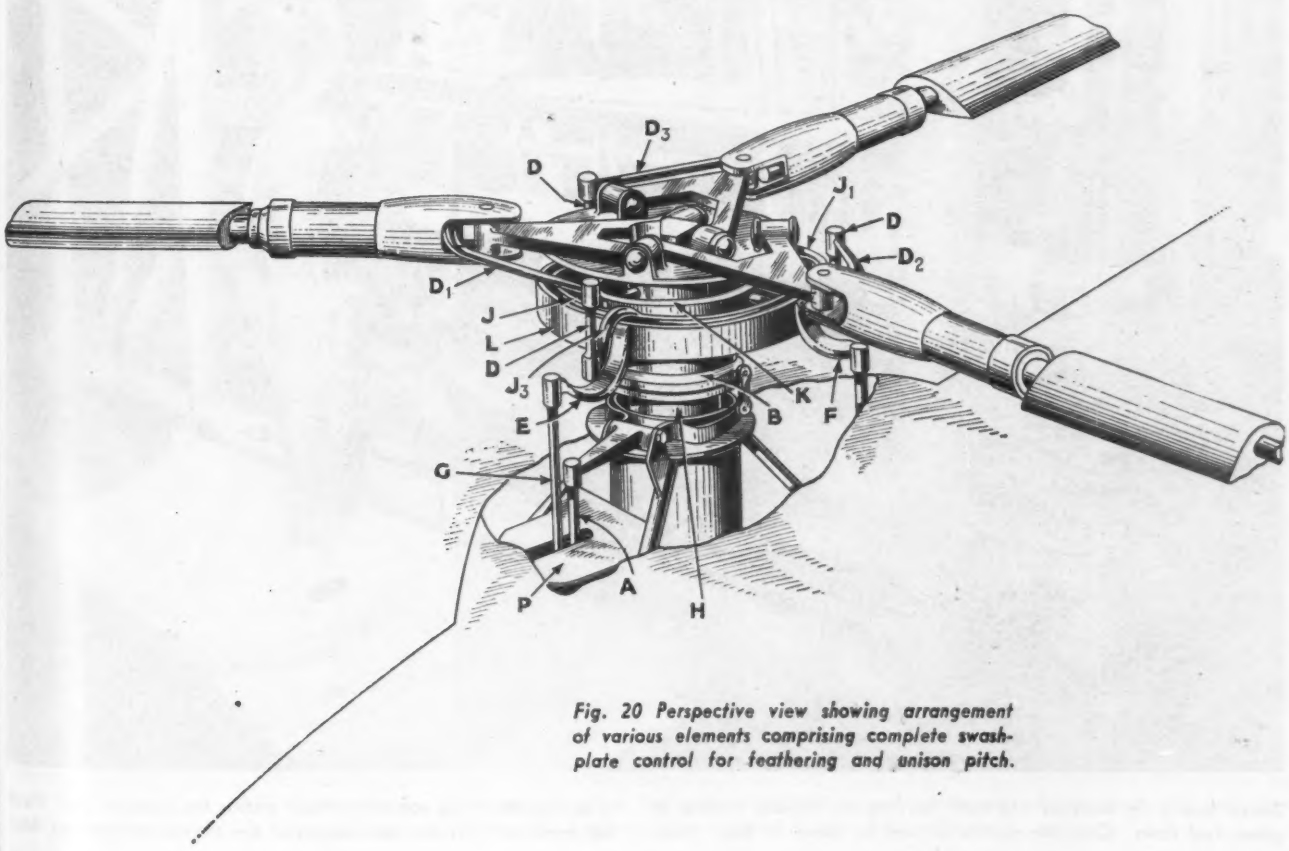


Fig. 20 Perspective view showing arrangement of various elements comprising complete swashplate control for feathering and unison pitch.

BETTER FUEL TANKS MADE FASTER

Difficulties in long-seam welding of tanks give way before C-W's combination of ingenious jig and Heliarc process. Resultant joint is smooth and stronger than tank skin, and wide peacetime use is foreseen for this fast mass-production welding method.

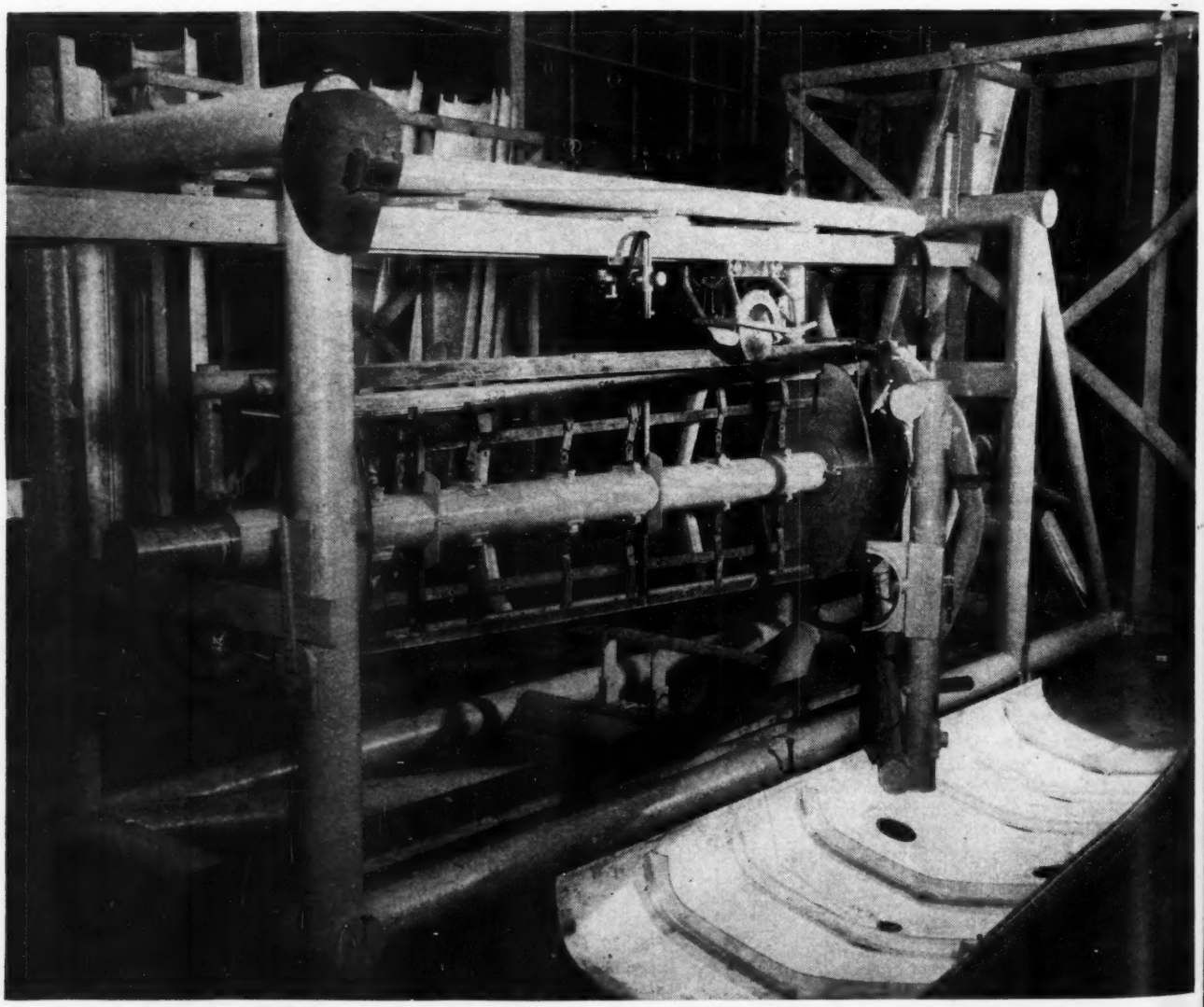
THE DOCTOR had made that wing-tank order quite clear: The huge cargo transports must have tanks specifically engineered to withstand the full stress and strain and vibration created by engines of thousands of horsepower—tanks that wouldn't leak at the seams no matter what tortures they were subjected to in the operation of the aircraft.

The order was for "fuel tanks with no seams"—in other words with seams stronger than the tanks themselves.

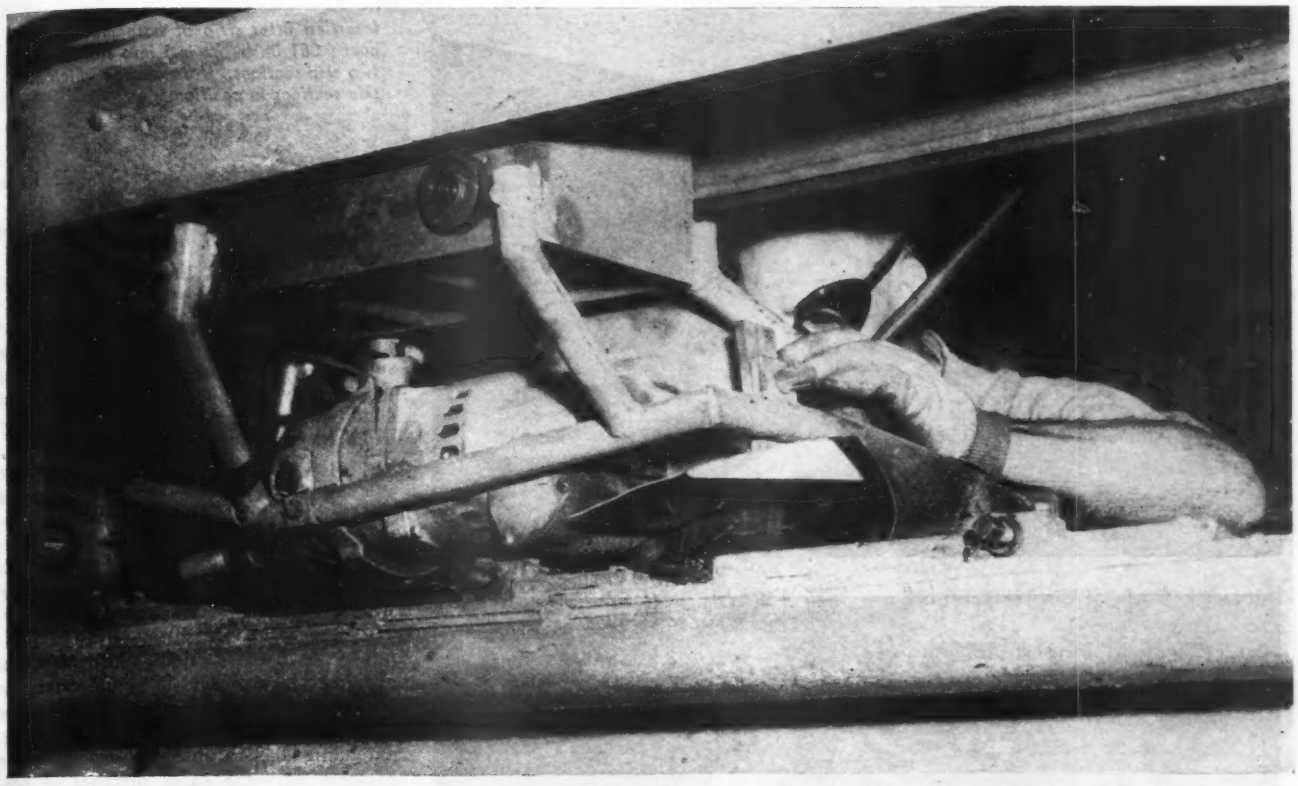
Expert craftsmen and engineers of the welding department of the St. Louis Plant of Curtiss-Wright's Airplane Division were given the job. They believed an adaption of the Heliarc welding process would be the answer.

The baffling problem in long-seam welding for mass production had been that of obtaining a smooth, steady application of the torch to the seam at an exact position above the bead, and at an even forward speed. It was almost impossible for a freehand welder to maintain such constants. Obviously, a form of mechanical straight-jacket was needed.

After months of study and experiment,



Shown here is jig designed and built for long-run Heliarc welding of plane fuel tanks. One side section of tank is shown on floor ready to be clamped in jig against identical section for opposite side. Welding head and circular saw employed are shown on overhead track.



Operator saws slot in top of joined sections of tank into which filler strip for weld is inserted. Slot, exact width of strip (.081 in.), automatically aligns joint and eliminates stress between sections to be welded.

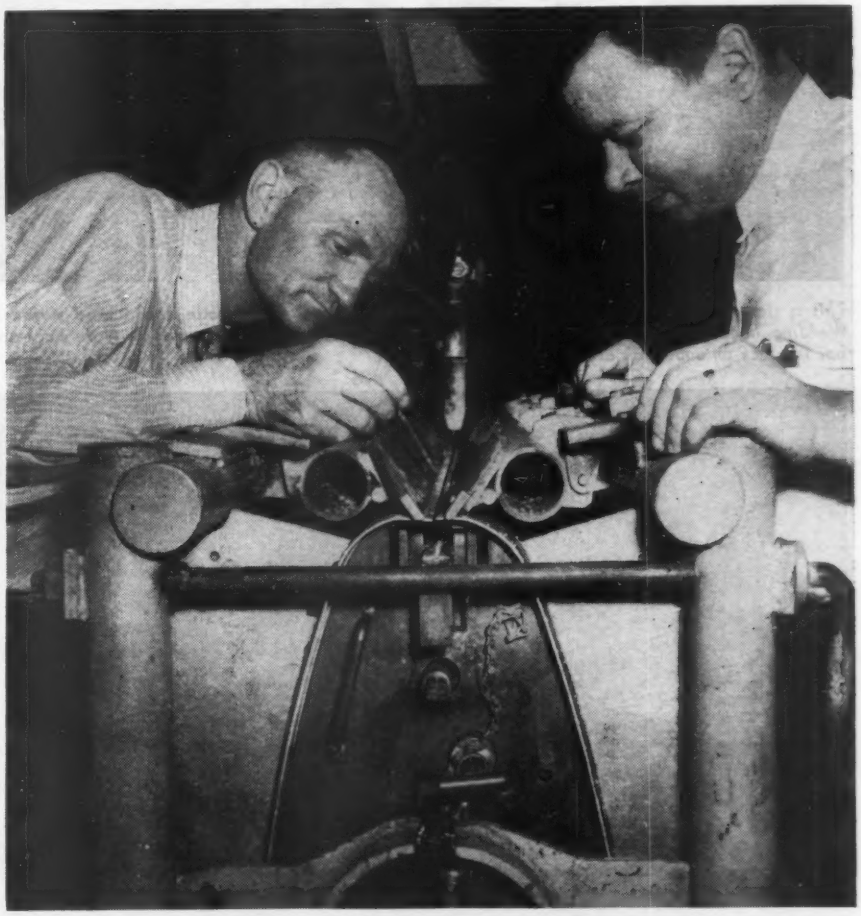
Curtiss-Wright perfected a jig to hold the tank and to control the two primary factors of welding head forward speed and position above the seam.

In this jig was incorporated an overhead track from which the welding head was suspended in an inverted position, swung on wheels, and operated by a small motor which powered the forward movement of the head. Along this track the welding head could be moved at any predetermined speed up to several feet a minute.

There were many primary variable elements to be taken into consideration and solved for mass production welding. Some of the more important included speed of the welding head, electrode diameter, length of arc and distance from bead, dimensions of filler strip, flux condition, flow of helium gas around electrode, temperature of back-up bar and clamps, fit-up of materials, and tensions. To correlate these factors required painstaking months of tests and study.

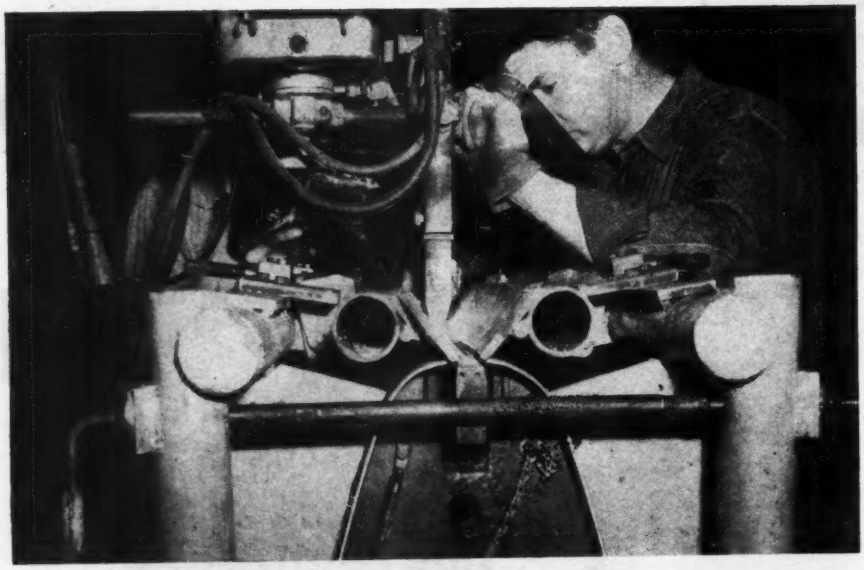
Experiments determined these fixed conditions: A forward speed of 1 ft. per min.; an amperage setting of from 76 to 85, depending on the welding machine used; and an arc length of $\frac{1}{16}$ in., the electrode riding .048 in. below the top of the filler strip which burned down ahead of the electrode. The electrode diameter was determined at $\frac{1}{4}$ in. as the ideal size for this operation. The filler strip, of the same 52S-$\frac{1}{2}$H as the base metal to be welded, was fixed at .081 in. thick and $\frac{1}{4}$ in. wide.

A very light application of flux was determined, the solution being painted on the weld surface in sufficient amount to permit seeping through to the underside

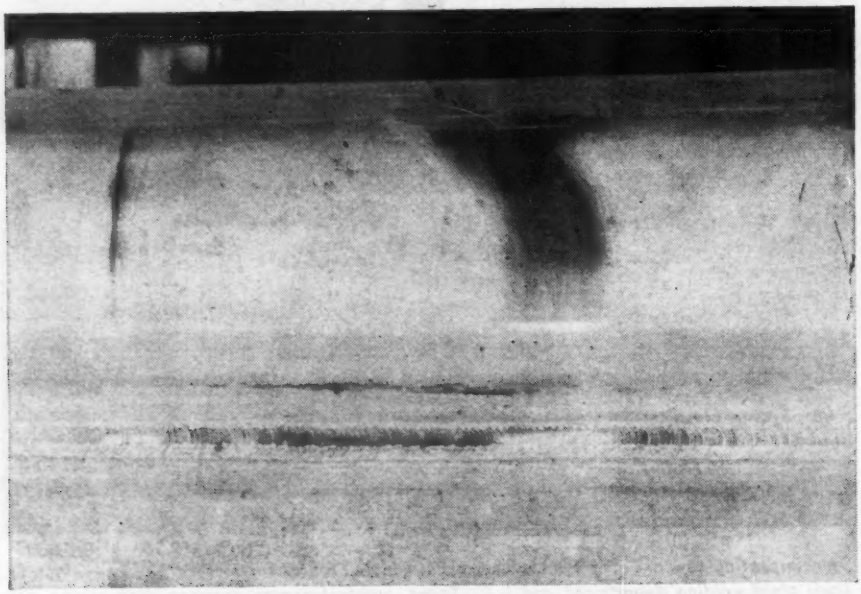


Seen inspecting sawed slot are E. F. Lohmann (right), general foreman of Curtiss-Wright St. Louis plant welding department, and I. C. Young, assistant general foreman. Note clamp bars which hold together two side sections of tank for welding, and welding torch with helium gas nozzle above electrode. Young points to slot which receives filler strip.

Inserting filler strip of base metal aluminum (.081 in. by 1/4 in.) into slot between two skin sections. Note clamps which hold skin sections in position.



This is start of process. Welder is shown controlling height of electrode above weld surface. Welding head moves forward 1 ft. per min. along 10 ft. bead to be welded. Note back-up bar in place on underside of weld.



Finished Heliarc long-run weld is smooth, shiny seam, of uniform width and thickness, giving added strength for entire length of tank.

of the filler strip. Alcoa No. 22 (pink powder) flux was used.

The flow of helium gas, breathed around the electrode through a surrounding nozzle, was 8 liters per min. No regulation of the temperature of the back-up bar or clamps was necessary, the heat generated in line production proving sufficient for that factor. Only a light pressure was found necessary for the clamps and back-up bar against the tank skins to be welded.

Two 10-ft. skin sections making up the side walls of the tank are positioned and clamped in the jig. A circular saw, which travels on the same overhead trolley as the welding head, moves the length of the tank, cutting a slot .081 in. wide where the two sections come together. This sawed groove automatically "justifies" the two sections, holding them clamped in position .081 in. apart, the exact dimension of the filler strip. The filler strip is then placed in this opening, extending .048 in. into the groove in the back-up bar—the same distance it protrudes above the base metal on top.

The welding head is then moved to the end of the tank, a light application of flux is made, and the power applied. The welding head moves the electrodes along the bead, the welder maintaining the electrode at the predetermined distance above the bead by a handwheel adjustor. Variation from side-to-side is also controlled (by means of another handwheel adjustment).

The weld for the 10-ft. sections requires approximately 10 min. for each side—1 ft. per min. being the forward speed of the welding head.

Reversing the tank in the jig to weld the other side requires but a few seconds. The sawing of the slot is repeated, the slot and general weld surface is cleaned by a power brush and compressed air hose, the filler strip is inserted, the flux is applied, and the job is again ready for the welder, the entire preparation requiring less than 5 min.

The second side weld completed, the tank is then ready for insertion of the interior baffles, the tank filler cap assembly, drain cocks, etc., before the end sections are welded by freehand method.

The long-seam Heliarc weld is a smooth, bright bead, approximately 25 percent thicker than the tank skin itself. Loss of an approximate 10 percent hardness in the welding is offset by a gain in tensile strength in ratio to the added thickness of the welded seam.

The operation of the Heliarc welding method with the jig setup is simple, fast, and economical, and foreseen is a wide peacetime adaption in the manufacture of aluminum alloy products.

Further developments with the process are under way in Curtiss-Wright's St. Louis plant welding department laboratories.

Analysis of Continuous Beams Having Variable Moments of Inertia

By **DONALD A. DuPLANTIER**, *Chief of Structures, Nashville Div., Consolidated-Vultee Aircraft Corp.*

Presenting a comparison of the conventional (constant I) and general (varying I) forms of the theorem of three moments for the more unusual conditions of beam loading.

THE USUAL FORM of the equation expressing the theorem of three moments is based on the assumption that the moment of of inertia of the continuous beam is constant within each span, though it may vary from span to span. There are occasions in the design of aircraft structures when it becomes necessary to analyze a continuous beam whose moment of inertia varies within each span. A procedure frequently used in such cases is to compute the arithmetic mean of the end moments of inertia in each span and then to analyze a substitute beam with constant moments of inertia equal to these mean values.

It is evident that such procedure gives approximate results, and the percent of error introduced is both unknown and unpredictable by inspection, sometimes being well over 20 percent. It is, of course, evident that no analysis can be more accurate than the basic assumption of loading characteristics and safe allowable stresses, but it would appear logical and reasonable to strive to eliminate, where practicable, intermediate approximations which are sources of error, since these will not necessarily neutralize each other but may accumulate to decrease the apparent margin of safety.

In line with this premise, the equation of the theorem of three moments has been modified to make it applicable to a beam whose moment of inertia is variable and, in its generalized form, it can be used to analyze any continuous beam, once the proper continuous-beam factors have been determined.

If the moment of inertia I in a given span can be expressed as a continuous equation, it is mathematically possible to obtain precise equations which will determine the values of the modifying coefficients. However, such equations become too cumbersome for practical use in essentially all cases but one—namely, where the equation for I is of the form: $y=(ax+b)^2$.

In all other cases it is much easier, and sufficiently accurate, to determine the coefficients by mechanical integration rather than by mathematical integration.

Fortunately, however, in aircraft structures the majority of beams with variable moments of inertia fall into the type of beam whose flanges are constant, whose depth tapers in a straight line, and whose web is very thin, with a negligible moment of inertia. Consequently the equation for I assumes the form: $y=(ax+b)^2$, as previously mentioned.

A comparison of the conventional (constant I) and general (varying I) forms of the theorem of three moments will now be presented for the more usual conditions of loading. The modulus of elasticity E is assumed constant, throughout. The terminology used will be as follows:

A, B, C,=Three adjacent beam supports in sequence, left to right.

M_a; M_b; M_c=Beam moments at A, B, C.

I_a; I_b; I_c=Moments of inertia of beam at A, B, C, when I is varying.

L_1; L_2=Lengths of spans 1 and 2.

I_1; I_2=Moments of inertia of beam in spans 1 and 2 (constant I).

$\alpha=L_1/L_2$

$\theta=I_1/I_2$ or I_2/I_1 whichever applies.

Case 1: Uniformly Distributed Load (Fig. 1).

Case 1(a): Constant I.

$$\left(\frac{L_1}{6I_1}\right)M_a+\left(\frac{L_1}{3I_1}+\frac{L_2}{3I_2}\right)M_b+\left(\frac{L_2}{6I_2}\right)M_c=-\frac{W_1L_1^2}{24I_1}-\frac{W_2L_2^2}{24I_2} \quad (1)$$

$$\text{or: } \alpha M_a+2(\alpha+\theta)M_b+\theta M_c=-\frac{L_2}{4}(W_1\alpha^2+W_2\theta) \quad (1a)$$

Case 1(b): Varying I.

$$\left(\frac{C_aL_1}{I_a}\right)M_a+\left(\frac{C_bL_1}{I_a}+\frac{C'_bL_2}{I_c}\right)M_b+\left(\frac{C_cL_2}{I_c}\right)M_c=-\frac{C_1W_1L_1^2}{I_a}-\frac{C_2W_2L_2^2}{I_c} \quad (2)$$

$$\text{or: } \alpha C_aM_a+(\alpha C_b+\theta C'_b)M_b+\theta C_cM_c=-L_2(C_1W_1\alpha^2+C_2W_2\theta) \quad (2a)$$

It is evident, by inspection, that Eq. (1) and (2), or (1a) and (2a), are in identical form and the modifying continuous-beam factors C_a; C_b; C'_b; C_c; C_1; and C_2 in Eq. (2) assume the values of 1/6, 1/3, 1/3, 1/6, 1/24, and 1/24, respectively, when applied to a beam of constant I (constant within each span).

It is also evident that the left hand side of each equation depends only on the elastic qualities of the beam and will be the same for any type of loading, whereas the right hand side must change with the loading. Therefore, to avoid repetition, in subsequent equations the left hand side will be designated by LHS(1), LHS(1a), LHS(2), LHS(2a), as the case may be.

Case 2: Uniformly Varying Load—varying uniformly from zero at outer support to a maximum at inner support (Fig. 2).

Case 2 (a): Constant I:

$$\text{LHS (1)}=-\frac{2}{45}\left(\frac{W'_1L_1^2}{I_1}+\frac{W'_2L_2^2}{I_1}\right) \quad (3)$$

$$\text{or: LHS (1a)}=-\frac{4L_2}{15}(W'_1\alpha^2+W'_2\theta) \quad (3a)$$

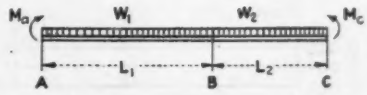


Fig. 1. Diagrammatic representation of uniformly distributed load.

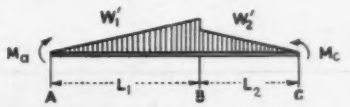


Fig. 2. Uniformly varying load—from zero at outer support to maximum at inner support.

Fig. 3. Uniformly varying load—from maximum at outer support to zero at inner support.

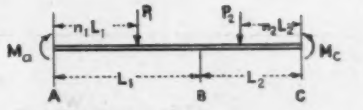


Fig. 4. Diagrammatic representation of concentrated loads.

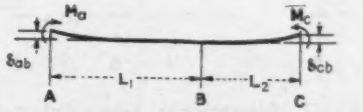


Fig. 5. Yielding supports showing deflection at A and C with respect to B.

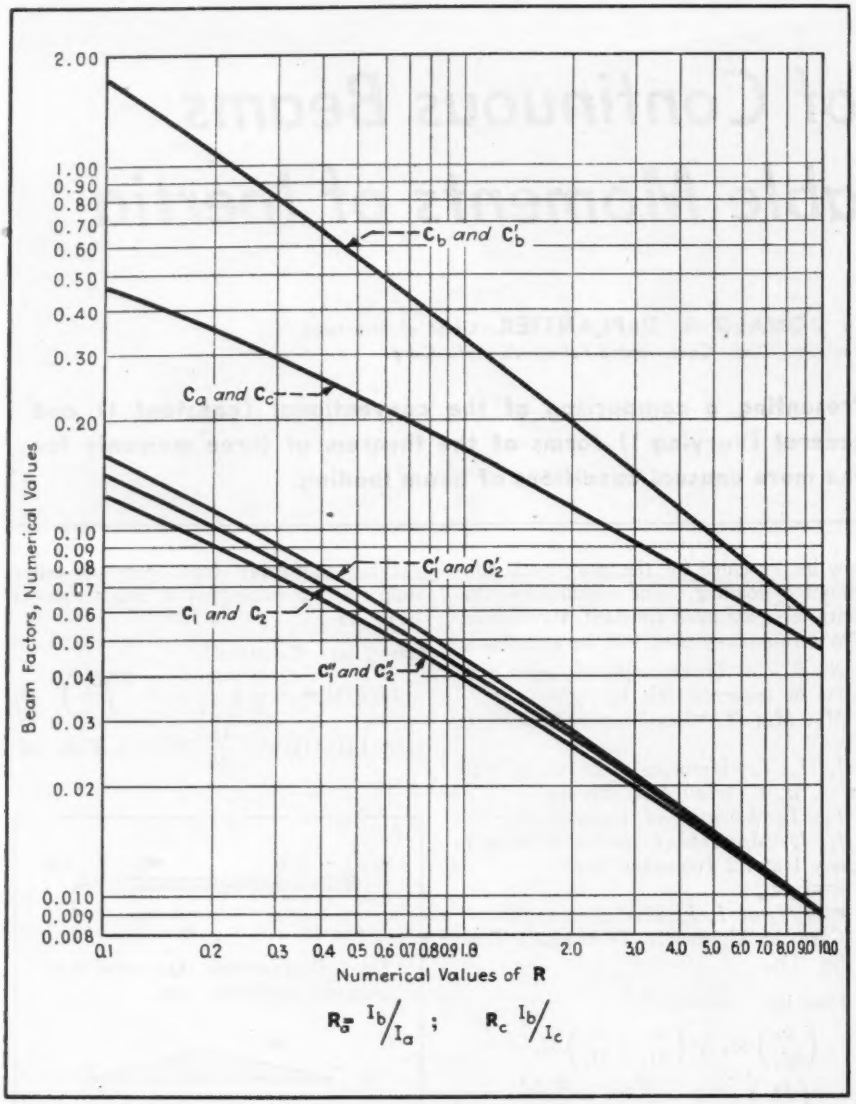


Fig. 6. Logarithmic graphs for determining numerical values of continuous-beam factors.

Case 2 (b): Varying I:

$$\text{LHS (2)} = -\frac{C'_1W'_1L_1^2}{I_a} - \frac{C'_2W'_2L_2^2}{I_c} \quad (4)$$

or: LHS (2a) =
$$-L_2(C'_1W'_1\alpha^2 + C'_2W'_2\theta) \quad (4a)$$

Case 3: Uniformly Varying Load—varying uniformly from maximum at outer support to zero at inner support (Fig. 3).

Case 3 (a): Constant I:

$$\text{LHS (1)} = -\frac{7}{180}\left(\frac{W''_1L_1^2}{I_1} + \frac{W''_2L_2^2}{I_2}\right) \quad (5)$$

or: LHS (1a) $= -\frac{7L_2}{30}(W''_1\alpha^2 + W''_2\theta)$ (5a)

Case 3 (b): Varying I:

$$\text{LHS (2)} = -\frac{C''_1W''_1L_1^2}{I_a} - \frac{C''_2W''_2L_2^2}{I_c} \quad (6)$$

or: LHS(2a) =
$$-L_2(C''_1W''_1\alpha^2 + C''_2W''_2\theta) \quad (6a)$$

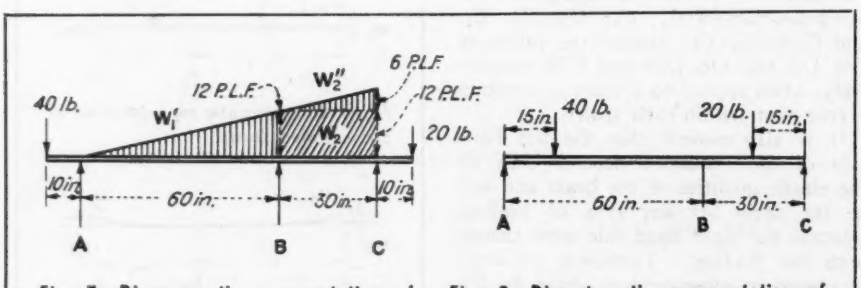


Fig. 7. Diagrammatic representation of loading for illustrative problem No. 1 (See text).

Fig. 8. Diagrammatic representation of loading for illustrative problem No. 3. (See text).

It is to be noted that if one span has Case 2 loading and the other has Case 3 loading, the beam factors applicable to each span-case must be used.

Case 4: Concentrated Loads (Fig. 4).

Case 4 (a): Constant I.

$$\text{LHS (1)} = -\frac{1}{6}\left[\frac{P_1L_1^2n_1(1-n_1^2)}{I_1} + \frac{P_2L_2^2n_2(1-n_2^2)}{I_2}\right] \quad (7)$$

or: LHS (1a) $= -L_2[P_1\alpha^2n_1(1-n_1^2) + P_2\theta n_2(1-n_2^2)]$ (7a)

Case 4(b): Varying I.

$$\text{LHS (2)} = -\frac{C'''_1P_1L_1^2}{I_a} - \frac{C'''_2P_2L_2^2}{I_c} \quad (8)$$

or: LHS (2a) =
$$-L_2[C'''_1P_1\alpha^2 + C'''_2P_2\theta] \quad (8a)$$

Case 5: Yielding Supports (Fig. 5). In the event the supports of a continuous beam yield, so that the supports at A and C deflect a distance δ_{ab} and δ_{cb} with respect to B, in a manner similar to that shown in Fig. 5, bending moments are induced in the beam and can be computed by use of the following formulas, wherein an upward relative displacement is considered as positive, and downward as negative.

Case 5(a): Constant I.

$$\text{LHS (1)} = E\left(\frac{\delta_{ab}}{L_1} + \frac{\delta_{cb}}{L_2}\right) \quad (9)$$

or: LHS (1a) $= \frac{6EI_1}{\alpha L_2^2}\left(\delta_{ab} + \alpha\delta_{ab}\right)$ (9a)

Case 5(b): Varying I.

$$\text{LHS (2)} = E\left(\frac{\delta_{ab}}{L_1} + \frac{\delta_{cb}}{I_2}\right) \quad (10)$$

or; LHS (2a) $= \frac{EI_a}{\alpha L_2^2}\left(\delta_{ab} + \alpha\delta_{cb}\right)$ (10a)

Continuous-Beam Factors

In all of the preceding equations involving a varying moment of inertia, certain continuous-beam factors have been introduced to account for this condition. The equations for these factors are listed in the appendix to this article, but the numerical values can be determined directly from the logarithmic graphs plotted in Fig. 6, once the governing values of R_a (or R_c as the case may be) have been computed. These ratios are identified by the equations:

$$R_a = \frac{I_b}{I_a} \quad (11)$$

$$R_c = \frac{I_b}{I_c} \quad (11a)$$

It must be borne in mind that the equations of the curves in Fig. 6 are predicated on the relationships expressed by the equations:

Span A to B: $I_k = I_a(ak+1)^2$ (12)

Span C to B: $I_k = I_c(ak+1)^2$ (12a)

In Eq. (12): $a = \sqrt{R_a} - 1$

In Eq. (12a): $a = \sqrt{R_c} - 1$

In both equations, and all subsequent equations, k is a function of the span such that $x = kL$.

Eqs. (12) and (12a) are evidently of the same form as $y = (ax+b)^2$. (See discussion at beginning of article.)

(*Turn to page 297*)

Suspension Mount Controls Instrument Vibration

New principle smothers instrument-damaging impulses by breaking them up, then neutralizing each part in turn—an effective engineering application of the "divide and conquer" axiom.

VIBRATION, a major factor in the service life and weight of aircraft instruments, can now be controlled.

If there were no vibration to be contended with, design and upkeep of aircraft instruments and radio would be much simplified and their life prolonged far beyond that which is now considered normal.

Unfortunately, however, perfect balancing of moving engine parts and propellers is not possible, although engineers have accomplished remarkable feats in minimizing vibration in these high-speed units.

Since vibration cannot be completely eliminated, the designer has to make a choice between short instrument life or extremely heavy construction, neither of which is desirable in an airplane where light weight and reliability are not only requisite but are considered to be absolutely essential.

The solution to the problem, since vibration cannot be eliminated, is to prevent this destructive motion from reaching the instrument, without adding to the total weight of the equipment any more than is absolutely necessary. The Robinson suspension mount, here described, has been designed to absorb 90 percent or more of all engine and propeller vibration by means of a radically new arrangement of simple components.

Because each unit is designed to suit the weight and vibration conditions peculiar to individual installations, only a general description of the principles of this device can be given.

When a mass such as an instrument panel is supported at, or near, the corners, it has been found that the peculiar type of oscillating vibration present in aircraft will either be transmitted in full or ampli-

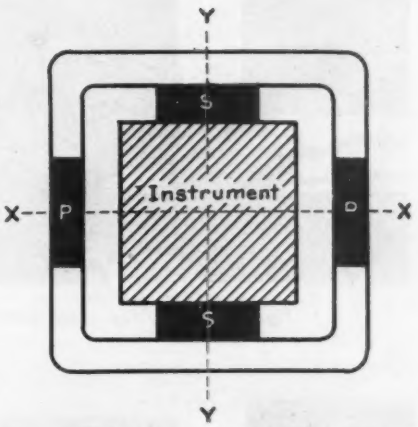


Fig. 1. Suspension principle of Robinson mount. X-X and Y-Y are instrument axes. P-P and S-S are primary and secondary cushions. Each set of pads absorbs vibration in one direction.

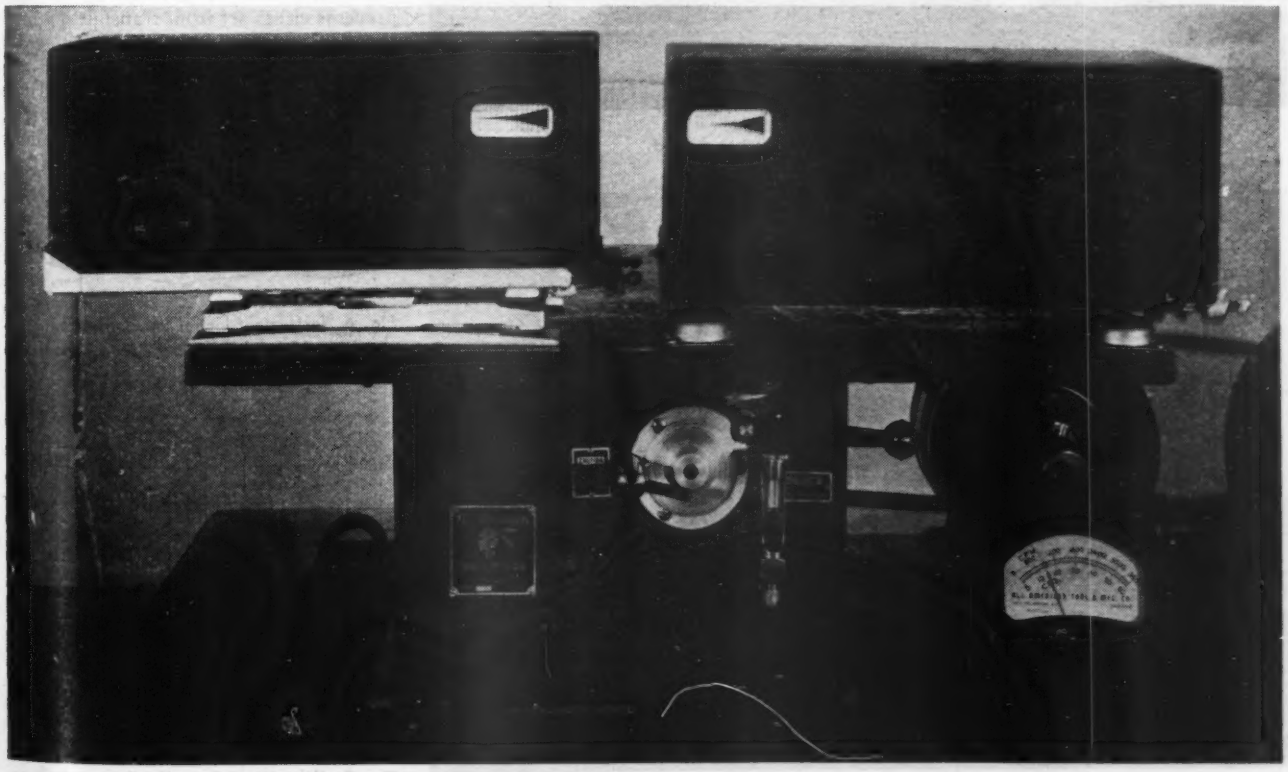


Fig. 2. Robinson mount (left) and corner suspension (right) on vibration table. Vibrometers on sides of instrument cases show comparative motion. Vibration of 15 cycles per second (shown on tachometer) amounts to .060 in.

fied, to the detriment of the instruments. The corner mounts, being at a maximum distance from the neutral axis of the airplane, receive this oscillating vibration in a maximum amount. It has been shown also that longitudinal, lateral, and vertical vibration are present in the airplane structure in equal or variable amounts, and many shock units cannot absorb this multi-directional motion.

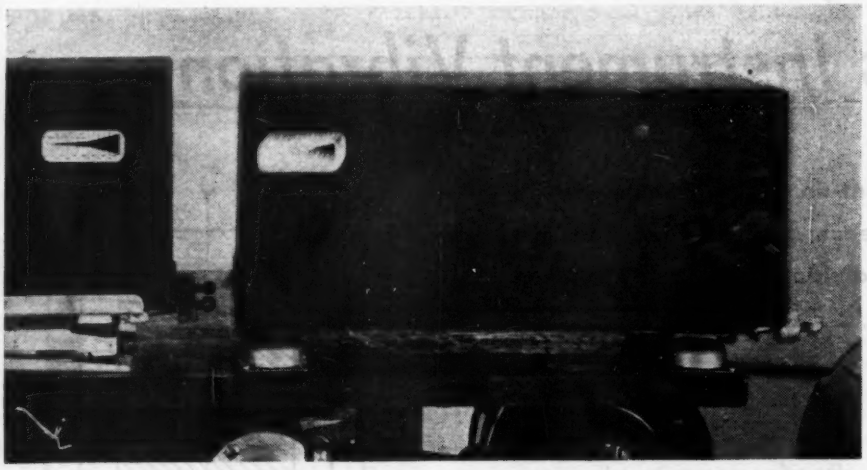


Fig. 3. Same as Fig. 2 but with vibrations raised to 20 per second.

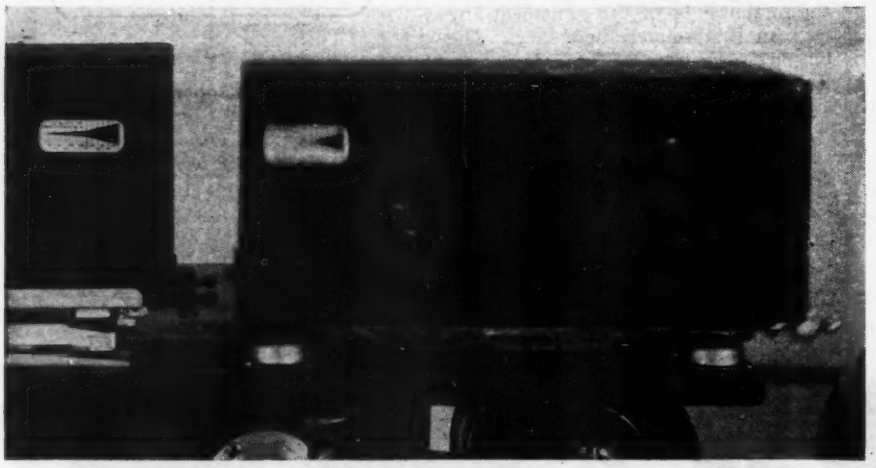


Fig. 4. Same with vibrations at 30 per second.

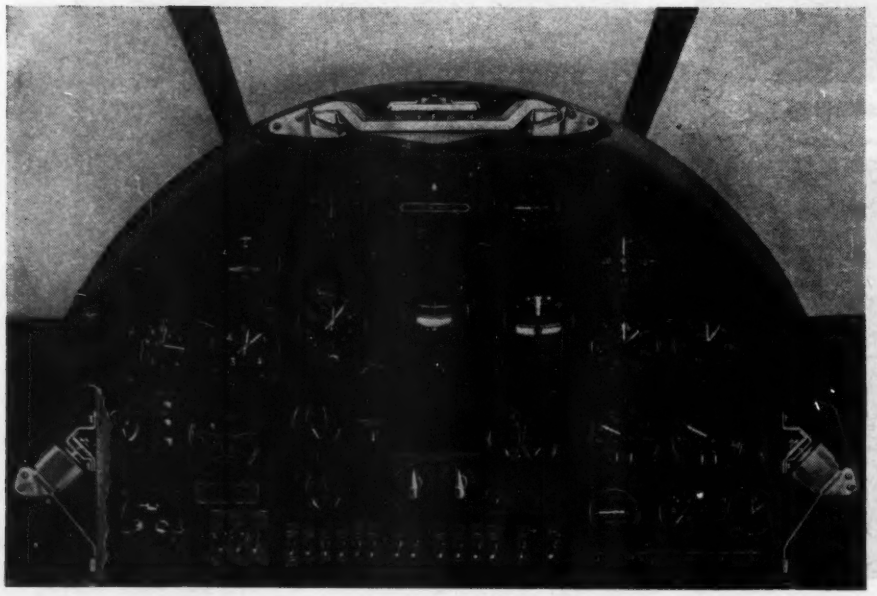


Fig. 5. Cutaway illustration shows vibration-absorbing instrument-board suspension. Panel is suspended from top center, and side fittings are merely for dampening side-sway.

A Robinson suspension carries the entire weight of the panel from a point at, or near, the gravity axis of the airplane and panel, utilizing one set of cushions disposed about the fore and aft axes and another independent set disposed about the lateral axis, thus absorbing oscillations with negligible transmission to the panel.

The dual floating construction used is capable at the same time of absorbing all multi-directional impulses. The obvious answer is that several pads, in series, each with a specific part of the absorption to perform, should be provided, instead of one alone. It is the old story of several specialists being better than a jack-of-all-trades.

Fig. 1. offers a diagrammatic sketch of the principle involved. The instrument in center is supported on its axis *Y-Y* by two sponge rubber blocks *S-S*. These blocks and their frame are in turn supported at the other axis of the instrument by other sponge rubber blocks *P-P* attached to the base of the unit.

Action in absorbing oscillating vibration is as follows: Initial impulses are partly neutralized by the primary cushions *P* which deaden motion about axis *Y-Y* but have little influence on motion about axis *X-X*. Motion about *X-X* is transmitted to cushions *S-S* which, as they have only one motion to absorb, can be made sufficiently lively to do this efficiently, as was also the case with cushions *P-P*.

Consequence is that all oscillating vibration about any axis is neutralized by sets of cushions placed each for its specific purpose. The position of the cushions at (or closely on each side of) the center line of gravity of the unit, prevents either set from transmitting more than an extremely small percentage of torsional vibration.

The usual amounts transmitted are shown in Fig. 2 and 3. Vertical, lateral, and longitudinal vibrations are cared for

(*Turn to page* 266)

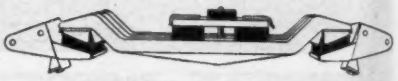


Fig. 6. Instrument panel shock-absorbing suspension which will support 60 lb. panel with load factor of 6 G's.

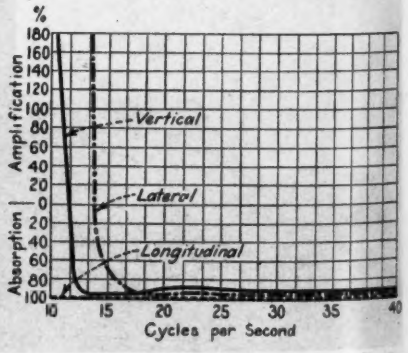
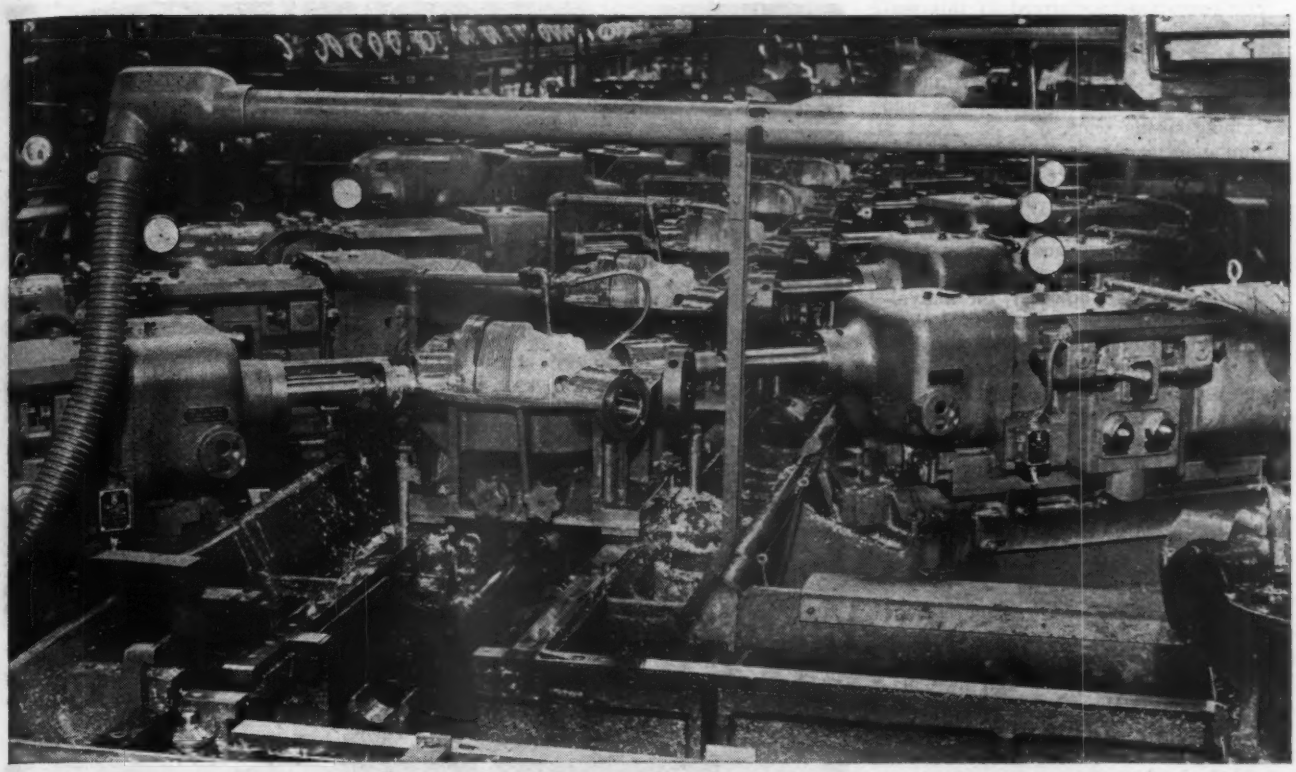


Fig. 7. Vibration absorption curve indicates that practically all vibration is neutralized at normal engine speeds.



Loading station, with part of one loaded fixture at right. At left center is a fixture in first machining station, and back of it four other fixtures at successive stations. Between ways is one of hydraulically reciprocated bars which shift fixtures from station to station between machining operation. After shift, each fixture is positively positioned by retractable pins.

Mass Machining Features Buick Shortcuts

By HERBERT CHASE

Ever intent on new means to do jobs quicker in less man-hours, this company's production men came up with three machines requiring only 7 operators—to take the place of 36 units and 30 men.

As BUICK EXPANDED ITS CAPACITY, company production men were constantly finding ways of doing jobs faster and with fewer man-hours per piece. This not only has made for economy but aided in meeting labor shortages.

In doing certain operations on Pratt & Whitney cylinder heads at Buick, 15 different machines were formerly used, each with its own fixture. Heads were shifted from fixture to fixture, being clamped and unclamped in each. This involved possible inaccuracies besides the labor of handling. Why not, it was argued, keep the heads in single fixtures, shifting them automatically?

Machines already in use did not lend themselves to such a setup, but since all operations could be done on machines having spindles that feed and return automatically, a maker of such machines was consulted. The result was a single Foote-Burt machine having 16 spindles arranged around a square base along which 18 duplicate fixtures are shifted automatically from station to station until they return to the starting point for unloading and reloading.

This machine handles considerably greater production than was possible in the prior arrangement, at the same time effecting an unusual saving in man-power. It is operated by three men. The individual heads driving the spindles are substantial duplicates and are arranged at an angle to the long sides of the oblong base. Each head is advanced to a fixed stop hydraulically, but the controls are all electric and are concentrated (except for emergency stop switches) in a single control panel on which pilot lights indicate how the respective heads operate.

One man loads fixtures, taking heads from a feeding conveyor at one end of the machine. Another, at the same end, unloads the fixtures and puts the machined heads on another conveyor. The third man watches the machine and stops and starts it manually if necessary.

All fixtures are duplicates and not only position the work but carry bushings for guiding each of the tools used, thus acting as jigs also. Fixtures are advanced by reciprocating bars equipped with latches which, after moving the fixtures to the next station, return and are ready for the next advance. No move occurs until all spindles are withdrawn automatically, when the tools they carry have completed their cuts. Then all the fixtures are moved ahead one station simultaneously.

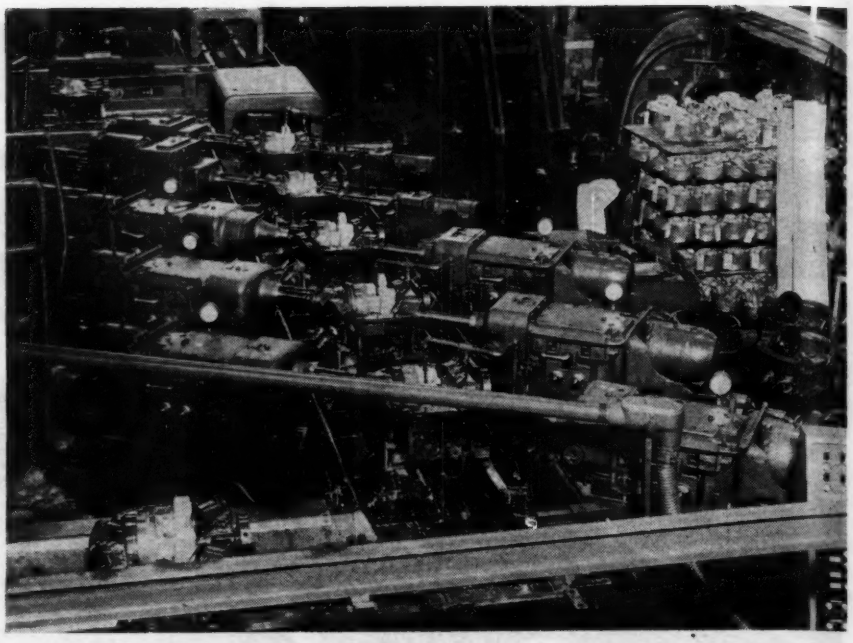
Fixtures slide on ways, and they are hydraulically locked (after precise locating pins are engaged) before the tools again advance and make their cuts. There is a separate feed bar along each side and each end of the machine, but no operations are performed along the end opposite to that at which loading and unloading is done. At two stations where the cut made is well inside the casting and where a tool piloted in the fixture alone might run out, a ram, carrying a pilot bushing, is advanced inside the casting to engage with a reamer pilot and assure the precision necessary.

The operations performed in this machine include: Machining of valve seats, cutting rocker box clearance, drilling and reaming valve stem guide holes, facing and chamfering valve guide holes, and machining spring seats.

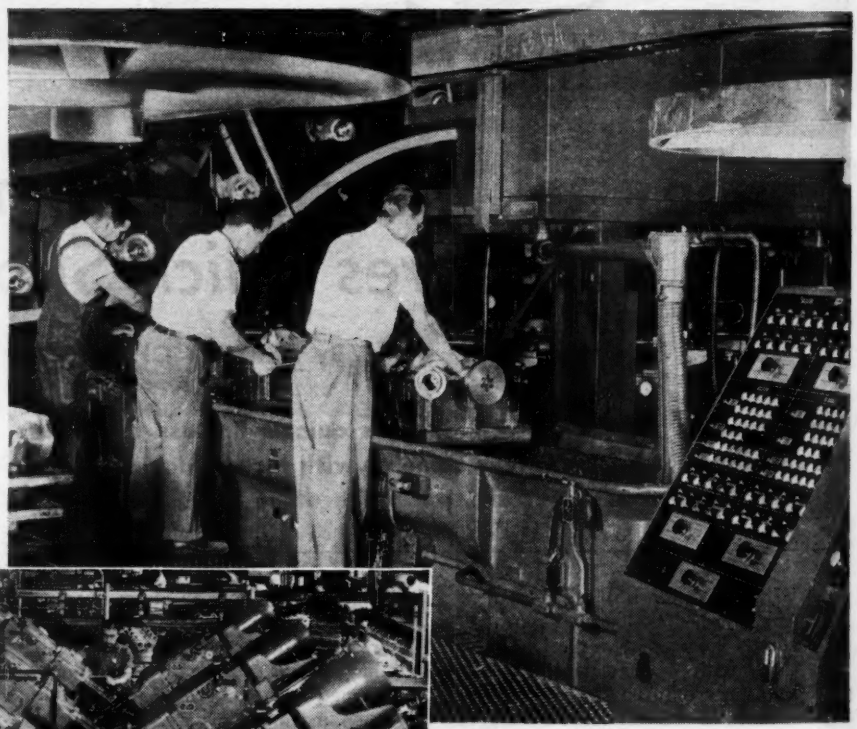
Similar principles are incorporated in another new Foote-Burt machine having ten spindles and taking the place of 15 separate machines formerly used by Buick for spot facing and other machining operations on rocker arm bushing holes. In this case, however, the individual heads are inclined in the vertical plane (because of the angle at which the tools must be advanced in reference to the work) and all the machines are arranged along ways extending the length of one side of the base.

A chain along the other side of the machine returns the fixtures, after they are unloaded, to the loading end. On the way, they pass through a tunnel in which they are washed by jets of coolant to free the fixtures of chips.

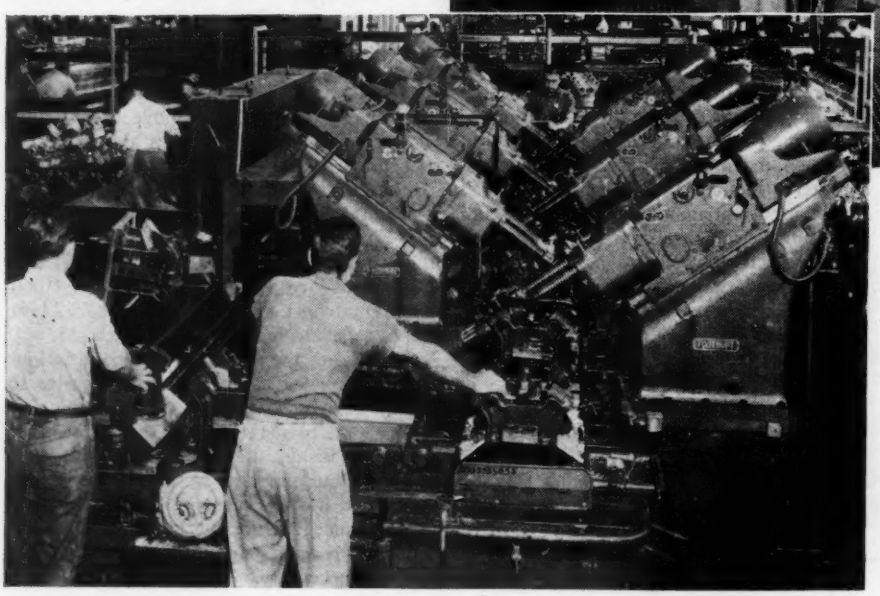
In this machine, after loading is done at one end, the fixtures are advanced by a rod with latches, as in the first machine. They pass successively through each machining station and are unloaded by hand at the opposite end. Fixtures are slid across the short ends of the machine by hand. As in the other machine, the head remains in the fixture during all the operations. Pins, inserted by hand and passed through holes previously machined, hold the head in the fixture. Each fixture carries bushings by which it is located positively at each station. A third man (one of two stationed at the loading end) tends the machine and aids in shifting the fixtures transversely. The tools, however,



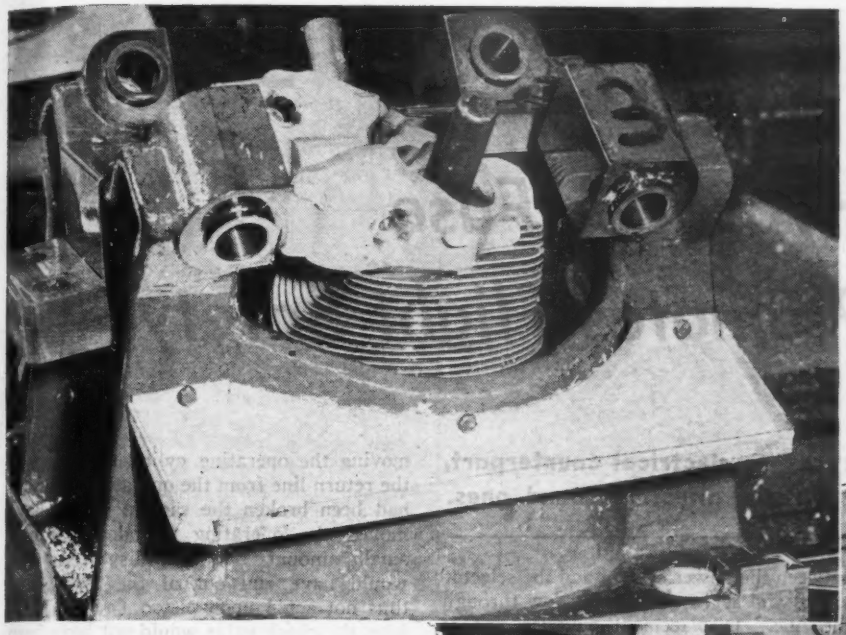
Return side of machine, with fixtures in each of five final machining stations, two farthest of which are those where rams, passing through locating holes, carry pilots for reamers advanced from opposite side. Guide bushings along this side of machine are at alternate corners of fixtures from those used along opposite side of machine.



Operators (at right) unload fixtures and reload them, one man handling controls in panel (extreme right) and keeping an eye on functioning of machine as a whole. Conveyors, one of which is seen in background, deliver heads ready for machining and carry away heads that have passed through the machining cycle.

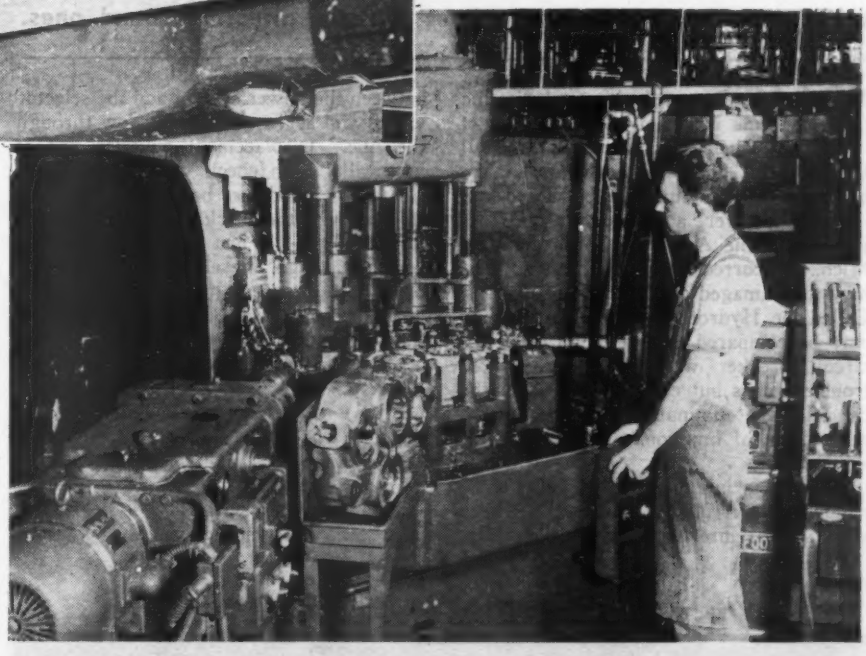


Left: Ten-spindle Foote-Burt machine as seen from loading end. Fixtures at right (except one in foreground which has just been loaded) are at various stations where rocker arm bushing holes are spot faced and otherwise machined. At left is track on which empty fixtures are returned after unloading at far end, the fixtures being sprayed with coolant (in tunnel on way back) to free them of chips.



Closeup of fixture employed on 10-spindle machine. Cylinder head is positively located in fixture by removable pins having knurled handles. Bushings of corners of fixture receive pins, advanced by machining heads, to locate fixture and hold it positively at each of the several stations.

Below: Set-up for machining two rear crankcase sections simultaneously while a third is loaded on a dial fixture. Two working stations are at back, and loading station, with casting in place, is at front. Tools of horizontal units feed in automatically from left and right.



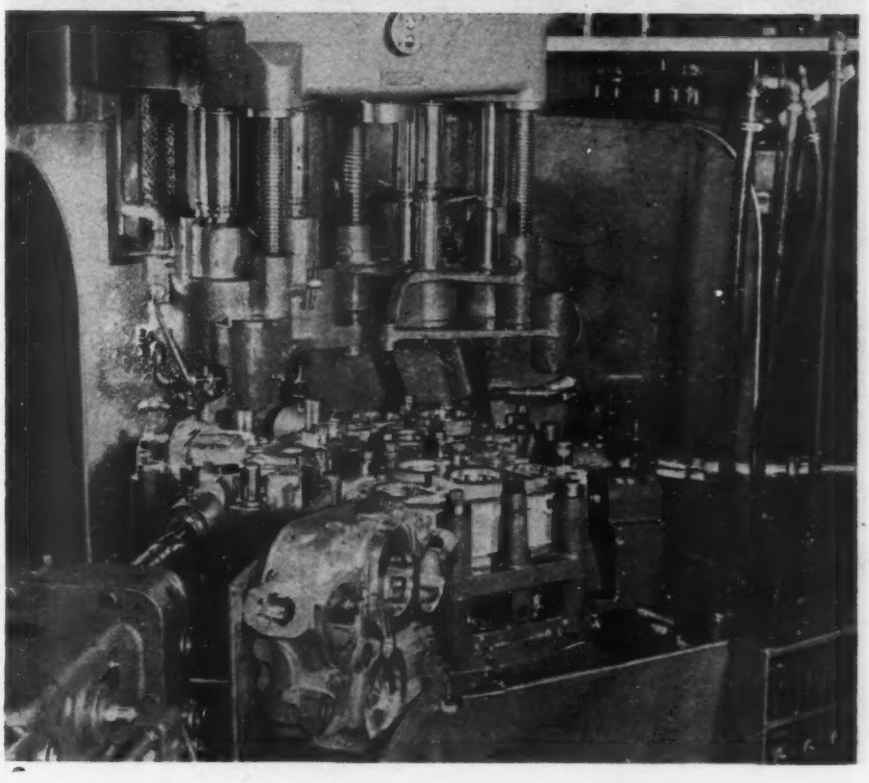
operate automatically in timed relation as the fixtures pause at each station.

Flat rear crankcases are rough bored and core drilled. And five pads, for two guns, a magneto, starter and generator, are spot faced in the third machine which replaces seven machines (radial drills and boring machines). With the new machine, one man takes the place of 6.7 men and handles 18 pieces an hour.

Basically, this machine is a multiple-spindle vertical drill with which are combined two horizontal boring units similar to those in the large machine first described. A three-place horizontal dial fixture is automatically indexed, two castings being in machining positions while the third is being loaded and unloaded. Of the two groups of tools in the vertical head, those at the left open the large holes in the horizontal face of the casting. At the same time, the horizontal spindle at the left is advanced for facing a side boss and boring a hole concentric with it.

While these operations proceed, the right group of vertical spindles bore some smaller holes on the preceding casting, and the horizontal machine at right machines another side boss on that casting. All the tools are advanced and returned hydraulically after cutting to precise depth. The vertical ones are all piloted in a part of the fixture which is lowered with them and is itself piloted on pins of the dial fixture below. There are also pilot bushings for the horizontal tools.

As with the other machines, the part remains in one fixture until completed, and there is only one handling into the fixture and one handling out of it. In this case, however, only three fixtures, all fastened to the dial, are needed.



Dial fixture with three castings in place ready for machining, the fourth, in foreground, being ready for loading. Vertical head with bushings for guiding tools is elevated. When lowered, it is piloted by fixture pins from below.

How the Hydraulic Fuse Promotes Flight Safety

Functioning with the same efficiency as its electrical counterpart, unit isolates leaky hydraulic lines without affecting sound ones.

VULNERABILITY of aircraft hydraulic systems is largely due to the fact that when one line is ruptured all the hydraulic fluid may be pumped overboard before the line can be closed off.

Now, however, a device has been developed by the Aeroquip Corp., Jackson, Mich., to correct this condition so that only the damaged circuits fail to function. Called the Hydrofuse (Fig. 1), its action may be compared to that of an electrical circuit breaker which shuts off when trouble occurs but can be reset when the condition is eliminated, thus permitting resumption of functioning of the undamaged circuits.

Basic principle of the device is very simple. Referring to Fig. 2, a check valve (a) is inserted in the pressure line between the power system and the selector valves and serves to prevent flow through the line. Displacement cylinder (e) is in parallel with check valve (a) so that a sample of fluid may be discharged downstream from the check valve even though it be closed. When this sample is directed through a selector valve to an operating cylinder, it moves the piston in that cylinder, thus displacing fluid from the other end. This returning fluid enters a small hydraulic cylinder (b) and moves its piston (g) before escaping through port (c) to the reservoir. The motion of piston (g) is transmitted by push rod (d) to the check value poppet and lifts it from its seat.

Now that the check valve is held open, fluid can flow through it and continue moving the operating cylinder piston. If the return line from the operating cylinder had been broken the sample would have moved the operating cylinder piston a small amount but the displaced fluid would have run out of the break and thus not acted upon piston (g). Therefore, the check valve would not have been opened and flow of pressure fluid would have ceased as soon as the sample was used.

If the pressure line (instead of the return line) had been ruptured, the sample of fluid would have gone overboard and the operating cylinder piston would not have been actuated. Since this piston was not moved it would not have displaced fluid and, consequently, no fluid would have acted upon piston (g) to move it and thus open the check valve.

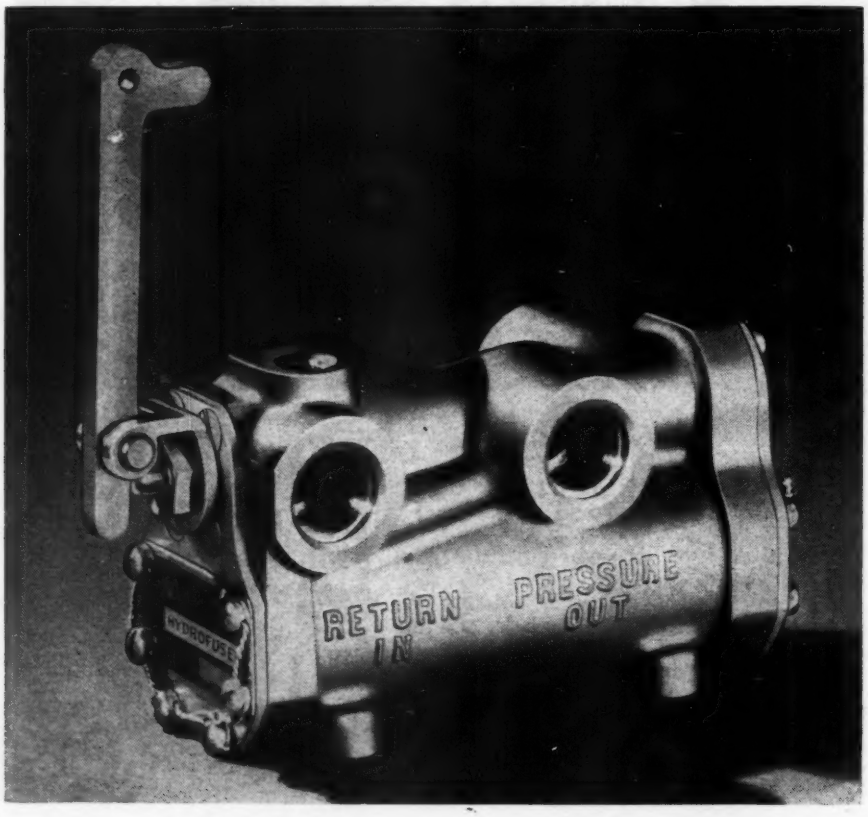
In the conventional *constant pressure* or *unloader* system, the fuse would be connected as shown in Fig. 3. The pressure fluid must run through the device before reaching the selector valves, and return fluid must traverse it before reaching the reservoir. If all selector valves are closed, there can be no fluid flow and the fuse remains in the "closed" condition. If some selector valve, such as (S), be opened, fluid pressure will be routed to the associated operating cylinder through either line (x) or line (y), the other line carrying return fluid back to the reservoir through the selector valve, and the fuse.

If either line (x) or (y) is broken the fuse will close, but when selector valve (S) is returned to the "off" position, which isolates the broken line, the fuse can be reset and will continue to operate normally on circuits controlled by selector valves (T), (U), (V), and (W).

The fuse would be installed in the *open center* system, as shown diagrammatically in Fig. 4. Since there is a continuous flow through the selector valves in series when they are all in "neutral" position, the fuse will normally stand in the *open* position permitting the flow to continue. If any selector valve is operated, the series passage is closed and the pressure fluid directed to an operating cylinder.

Return from this cylinder continues through the valve, the return line, the fuse, and to the reservoir. Consequently, the fuse remains *open*. If pressure had been directed to a circuit containing a broken line, the fuse would have closed, preventing waste. When the selector

Fig. 1. Aeroquip's Hydrofuse. It is 5 in. long and weighs 1.75 lb.



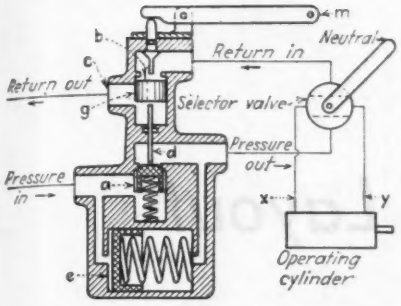


Fig. 2 Diagram of device. Letter references given here are keys to description of operation of fuse (see text).

valve is returned to *neutral*, broken lines are isolated and the fuse may be reset, allowing other sub-systems to function normally.

It is necessary to be able to reset the fuse after it has shut off. There are several reasons, such as bleeding air from the system, putting the system in operation after fusing, over-riding or forcing a one-way operation even when the return line is ruptured. An example of the latter is the case where the landing gear *up* line has failed and the pilot wishes to extend the gear even though the volume of fluid contained in the operating cylinders is lost.

There are three methods for resetting the Hydrofuse. Simplest and most desirable is the manual method when the fuse is placed in close proximity to the pilot. For this scheme it is only necessary to provide a cable or other attachment to the resetting lever (m) so the pilot may manually reset the fuse.

Second type of resetting is accomplished by connecting a small jumper line, in which a valve is placed, from the *pressure-in* port to the *return-in* port. This permits building up pressure against piston (g) which resets the fuse. A solenoid-operated valve in the jumper line may be desirable, due to the location of the fuse, and some limiting device should be used to prevent the jumper line valve from being held open for too long a time.

Third type of resetting is arranged by placing a jumper line with the valve from the *pressure-in* to the *pressure-out* ports. This jumper line is, in effect, a bypass and will permit operation of any operating cylinder not having a broken line even though the fuse be closed. When the operating cylinder moves it will establish a return flow which will reset the fuse in the normal manner. It is obvious that in the case where the return line is broken, an amount of fluid equal in volume to the operating cylinder displacement may be pumped overboard.

It is necessary that the fuse close promptly if the return line should fail while it is open. In order to achieve this a small amount of leakage must be provided past return piston (g). This is on the order of 20 cu. in. per min. and the fuse will not remain open at smaller return flows. Many hydraulic systems contain lap-fitted valves which may have slight leakage from the pressure side. If the displacement piston were leak-tight it would gradually shut off when used in this type of system.

To avoid this it is made with a leakage of approximately 8 cu. in. per min. to prevent closing at leakages such as might be expected due to "B" nut leaks, packing leaks, or similar seepages. This is a desirable condition, since this loss of fluid —slow and plainly evident—serves as a warning that repairs should be made. But it is not critical.

If either pressure header or return header is broken, the fuse will close, rendering all circuits inoperative with the exception of the brakes, which should be connected upstream from the fuse. If there were no fuse, the fluid would be pumped overboard and no circuits whatever would remain operative. This danger may be minimized by making pressure and return headers as short as possible and installing the fuse with its pressure connection far upstream and its return connection far downstream.

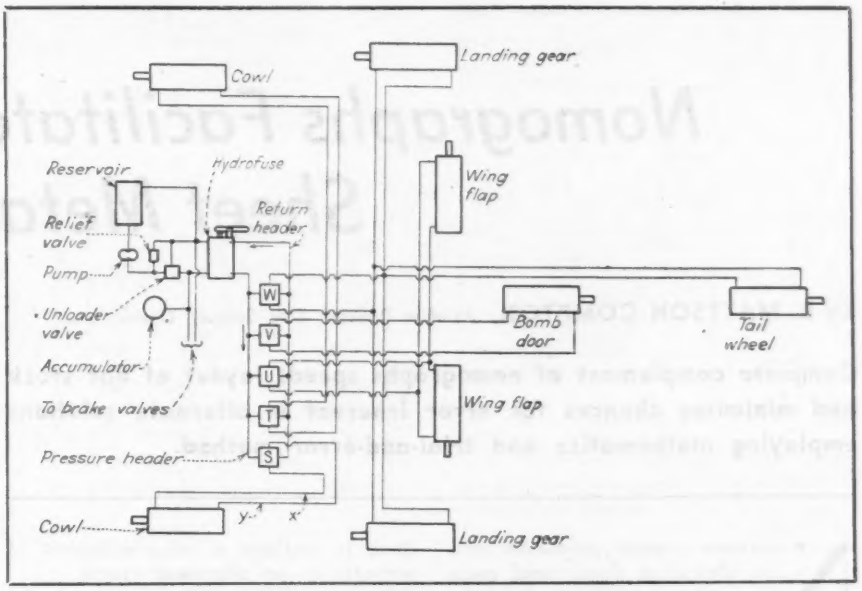


Fig 3. Hydrofuse installed in constant-pressure hydraulic system.

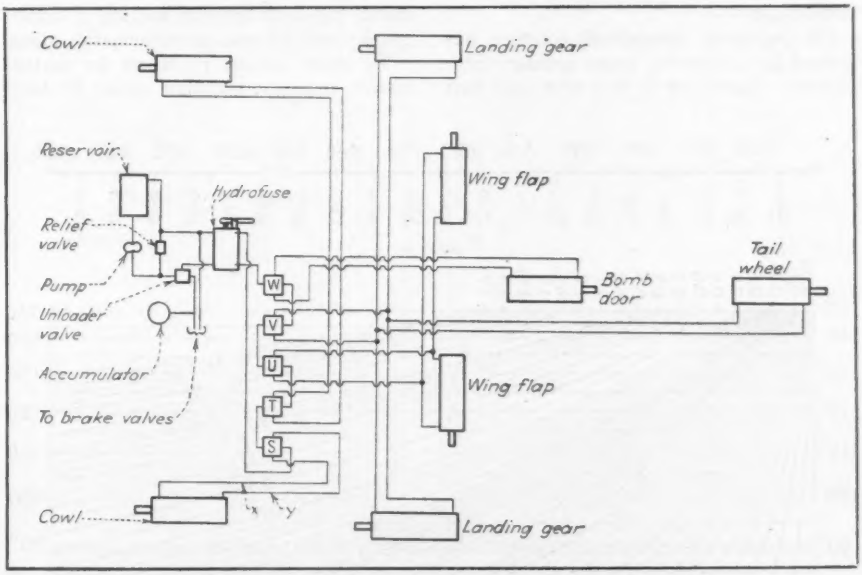


Fig. 4. Connections for device in open-center hydraulic system.

When fluid which traverses the fuse goes to a selector valve controlling the landing gear retraction and the gear is of a type which falls by gravity, it is necessary to use a run-around or cross-flow valve in the landing gear system, and it may be desirable to use a filler check valve in the down line. This is because the weight of the gear will force a return fluid flow while it is falling. Then, before the pump catches up, there may be a period when there is pressure flow with no simultaneous return flow, and the fuse would close. The above suggests a possible means of overcoming this undesirable condition.

The hydraulic fuse is not a panacea for all hydraulic system troubles, but if its limitations are kept in mind by the designer, it will prove to be of incalculable value in preventing crash landings and other accidents and incidents due to the failure of undamaged portions of the hydraulic systems.

Nomographs Facilitate Sheet Metal Layout

By **B. MATTSON COMPTON,** *Aviation Director, City Schools, Ogden, Utah.*

Complete complement of nomographs speeds layout of flat stock and minimizes chances for error inherent in alternate solutions employing mathematics and trial-and-error method.

NUMEROUS LAYOUT PROBLEMS arise in fabricating sheet metal parts from blueprint stage to completion. These can be solved by conventional mathematics, by trial and error, or by nomograph.

Of the three, nomograph solution has proved itself superior under ordinary conditions. Especially is this true now that there is available a full complement of nomographs or alignment charts.

We can easily see the contrast in the time element, in convenience, in chances for large errors, and knowledge of mathematics required between the use of nomographs and the use of mathematics alone.

To solve layout problems by mathematics requires adequate tables of bend allowance, trigonometric functions, and a working knowledge of trigonometry and algebra, as well as common arithmetic. The more calculations that are performed, the more chance there is for error.

By nomograph, layout problems become routine, requiring selection of the proper formula after which all terms of the formula can be immediately taken from the nomograph.

Nomographs have been used for years in engineering and technical fields. Most satisfactory results are obtained by using a transparent straight edge across the chart connecting the control conditions—then reading the answer where the straight edge cuts across the answer line.

Four charts accompany this article. Two of these—set-back chart (Fig. 1) and the combination B.A. & S. B. chart for 90 deg. (Fig. 2)—are similar to existing charts. The mold-leg chart (Fig. 3) was published earlier, by permission of the author, in an ASC manual. As far as is known, the bend allowance chart is presented for the first time. Practically all layout problems associated with sheet metal can be readily handled with these charts.

Most versatile of the four is the mold-leg chart, which is so useful in obtaining special quantities, such as inside set-back, location of bend layout lines, etc. When used to solve right triangles, the left scale is used for the side adjacent, the right scale used for the side opposite, and the diagonal line for the angle; but the values on the angle scale must be divided by two.

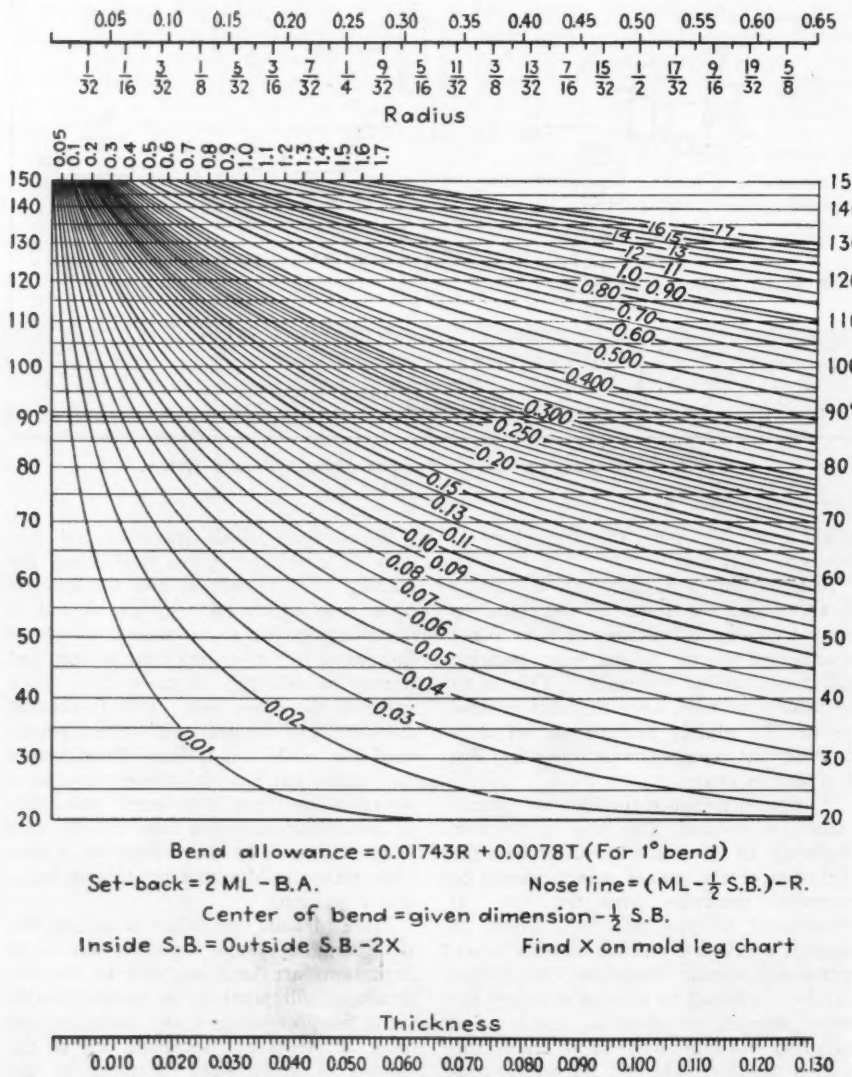

Radius
Bend allowance = 0.01743R + 0.0078T (For 1° bend)
Set-back = 2 ML - B.A.
Nose line = (ML - ½ S.B.) - R.
Center of bend = given dimension - ½ S.B.
Inside S.B. = Outside S.B. - 2X
Find X on mold leg chart
Thickness

Fig. 1. Set-back chart (outside) for sheet metal work.

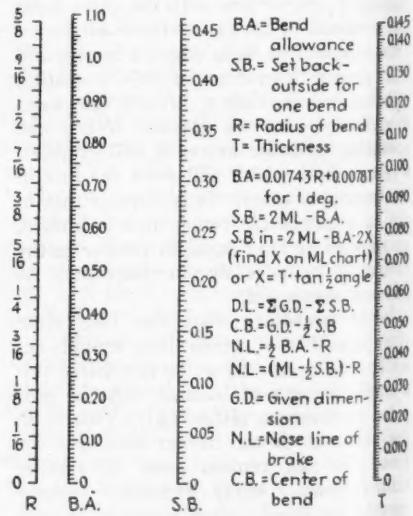

B.A. = Bend allowance
S.B. = Set back - outside for one bend
R = Radius of bend
T = Thickness
B.A. = 0.01743R + 0.0078T for 1 deg.
S.B. = 2ML - B.A.
S.B. in = 2ML - B.A. - 2X (find X on ML chart)
or X = T · tan ½ angle
D.L. = ΣG.D. - ΣS.B.
C.B. = G.D. - ½ S.B.
N.L. = ½ B.A. - R
N.L. = (ML - ½ S.B.) - R
G.D. = Given dimension
N.L. = Nose line of brake
C.B. = Center of bend
R
B.A.
S.B.
T

Fig. 2. Combination bend-allowance and set-back chart for 90 deg.

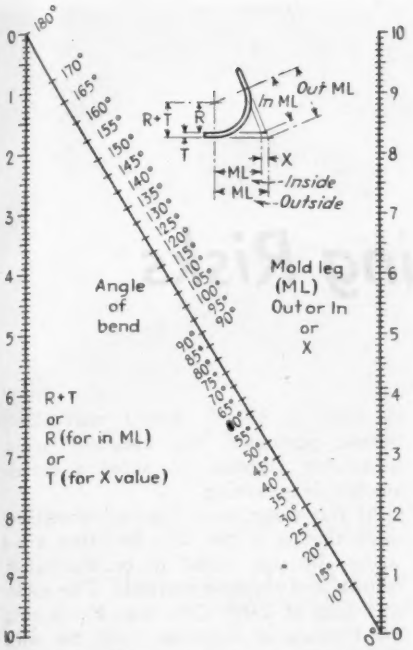


Fig. 3. Mold-leg chart for obtaining inside set-back, location of bend layout lines, etc.

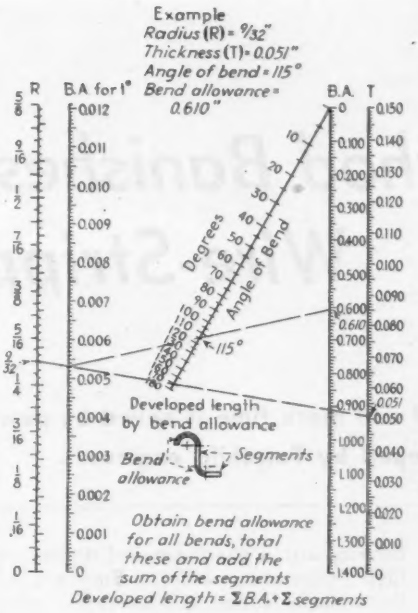


Fig. 4. Bend-allowance chart for 1 deg. through 180 deg. of bend.

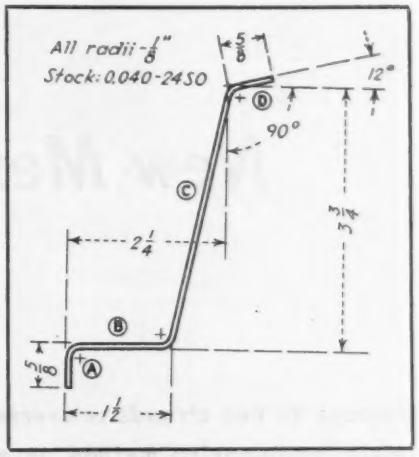


Fig. 5. Dimensions required for width of flat stock before bending.

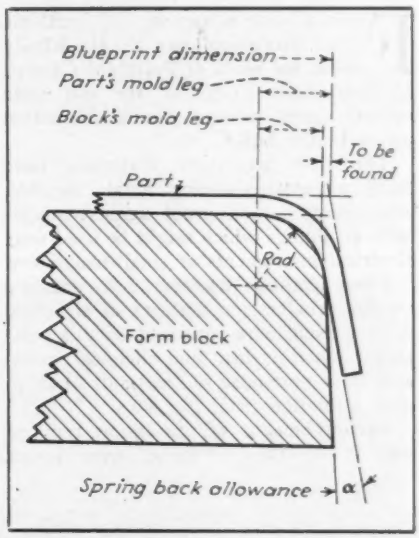


Fig. 6. Sheet metal form block layout

For very small angles, the side adjacent and the hypotenuse are practically equal. Exemplary layout problems are:

1. Developed length and width. It is necessary to determine the flat dimensions of a part in calculating its weight. This occurs in the design stage. More important to the workman, the flat dimensions must be known to permit cutting of stock to such a size that when formed the part will conform to the blueprint. (An example will follow developing the width of the part shown in Fig. 5).

2. Template layout for the part. Important in template layout is determination of where to place bend lines, mold lines, or other lines depicting the bend.

3. Template layout for form blocks. When it is necessary to form a part over a form block, the accuracy of the block controls, to a large extent, the accuracy of the finished part.

A form block properly undercut for spring-back has its mold point at a position different from the part's inside or outside mold point. Since the part is dimensioned to its mold point, the problem devolves to that of finding the distance from the part's mold point to the block's mold point (Fig. 6). (An example will follow).

4. Layout line for aligning the part in the brake. Often this is left to the man in the shop, since different types of brakes require a different bend layout line. In quantity runs, the press brake is almost always used. For small quantities, and in repair shops, the cornice brake or bar folder is often used.

Layout for the bend to be made on the press brake is simplest, since the center of bend is used (Fig. 7). The center of bend, of course, is midway between the bend lines or the mold lines. Layout for the cornice brake is to allow the nose of the brake to be the reference position. Fig. 8 depicts the prime relationship of the factors. Once this relationship is understood, all difficulty of accurate bends in the cornice brake should disappear.

Numerical Examples

1. Developed width. The first step (regardless of which method—set-back or bend allowance—is selected), is to determine all mold point dimensions and angles of bend to an accuracy consistent with the accuracy required for the flat pattern. Generally, it is better that the mold point dimensions be to the same side of the stock making up the part.

Mold Point Dimensions	Angles of Bend
$A = 5/8 = 0.625$	A-B = 90 deg.
$B = 1\frac{1}{2} = 1.500$	B-C = To be found
C = To be found	C-D = To be found
$D = 5/8 = 0.625$	

Our example from Fig. 5 shows the part dimensions to opposite sides of the part in one instance. In practical work this often occurs. To make all dimensions to the same side of the part, we shall obtain the mold point dimensions to the inside mold point of corner B-C and solve for the other parts to be found.

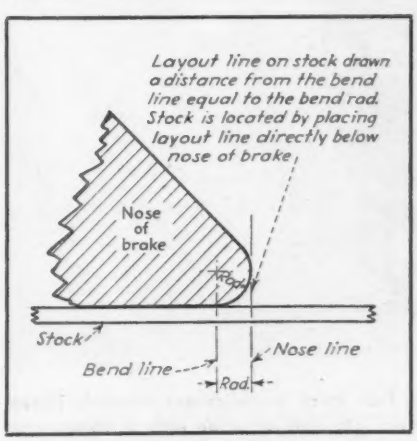

Layout line on stock drawn a distance from the bend line equal to the bend rad. Stock is located by placing layout line directly below nose of brake
Nose of brake
Stock
Bend line
Nose line
Rad.

Fig. 8. Bend location for cornice brake.

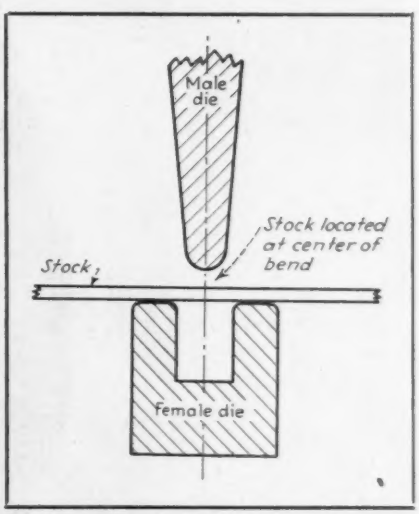


Fig. 7. Bend location for press brake.

It is necessary to know the angle of bend in order to determine mold legs. Use the mold leg chart or trigonometry to determine the apparent angle at corner B-C, then subtract from this the small angle formed by the edge of the metal and the diagonal line connecting the lower and

(*Turn to page* 303)

New Method Banishes Wire-Stripping Risks

Damage to fine strands is averted and much time is saved by new insulation-removing method developed by Fairchild engineers.

FORMEX AND FORMVAR, GE synthetic resin insulation, has almost wholly taken the place at Fairchild Camera & Instrument Corp. of the old style enamel, used where wound insulation would be too bulky.

The new insulation materials have many advantages—being tough, flexible, heat resistant, and proof against practically all liquids which might be used near electrical instruments or small machinery.

These qualities, however, have raised a serious problem for builders of electrical devices using wire insulated by this compound, since its heat and chemical resistance have outmoded old methods of stripping insulation from the wire.

Various means of insulation removal were tried—hand-scraping, wire brush, burning with a gas flame, and dipping in high temperature solder. But each of these methods had disadvantages, some very serious.

Objections to scraping No. 35 wire are obvious. The gas flame method frequently fused the fine (.005-0015 in.) wire, necessitating rewinding the instrument or armature. And dipping in hot (1,050-deg. F.) solder resulted in partial and sometimes complete melting of the wire. In cases where the wire was immersed in the solder for 11 sec. it disappeared completely.

Other more hazardous methods were tried, but they were abandoned because of danger to personnel. Concentrated sulphuric acid was discarded as being both a personal and operational danger. Caustic soda at 550 F. almost unavoidably burned personnel, the chemical action being too vigorous to avoid a certain amount of splashing.

At this stage, stripping and simultaneously tinning of the wire by using a hot solder dip was found to be the safest, fastest, and simplest method. The solder was kept at 1,000-1,100 deg. F., to strip the Formex or Formvar from the wire. Tinning was automatic and complete by the time the insulation had been removed.

Drawbacks were rapid oxidation of the solder, embrittlement of the wire, and charring of insulation above the stripped section, but more especially necking down of the stripped wire due to the combination of the copper with the solder at the necessarily high temperature. In addition, wires finer than No. 40 could not be dipped since their mechanical strength was insufficient to overcome the surface-tension of the solder.

New Way Devised

In view of the above disadvantages, it was obvious that some new method was essential in order to overcome this bottleneck in the manufacture of electrical products using fine insulated wire. Thereupon, two members of Fairchild's engineering staff, Victor J. Canzani and Frank W. Stellwagen developed a new technique after much experimentation.

They specifically planned to avoid the effects of (a) embrittlement of the copper wire from the use of high temperatures; (b) charring and hardening of the insulation near the stripped section; and (c) dissolving of the copper in the hot solder used in the stripping-tinning operation. At the same time the process embodied (a) simplicity, by making the

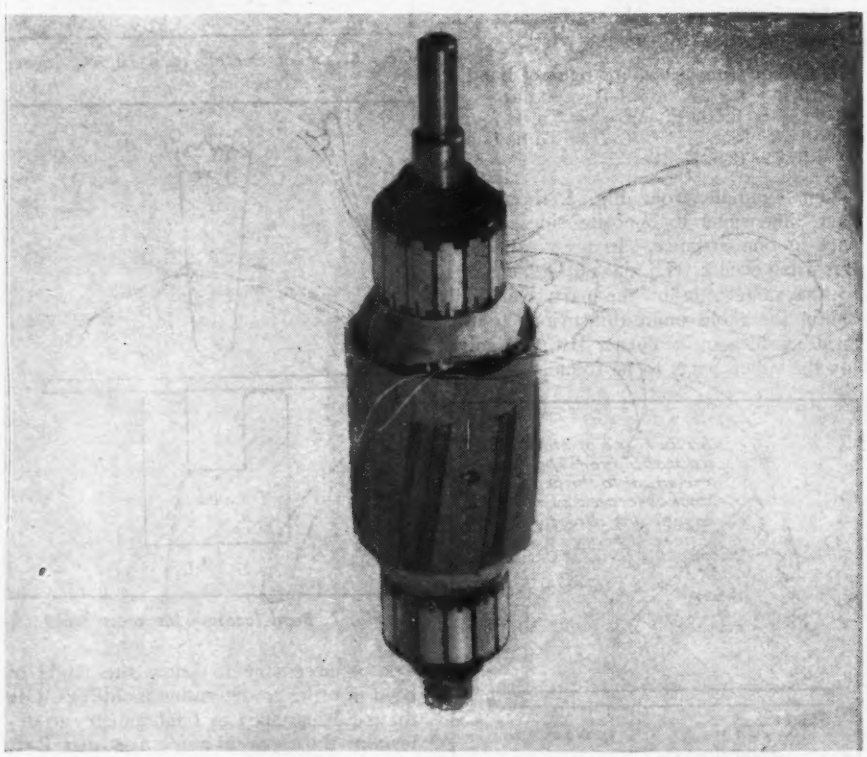


Fig. 1. Armature of 1⅛-in. dia. showing fine wires from which insulation was stripped. Tinned ends of wire, after trimming to length, are soldered into slots at inside ends of commutator segments. Damage to one of these would entail rewinding most of armature.

Frank Stellwagen (left) and Victor J. Canzani (right), inventors of Fairchild's patented wire-stripping method.

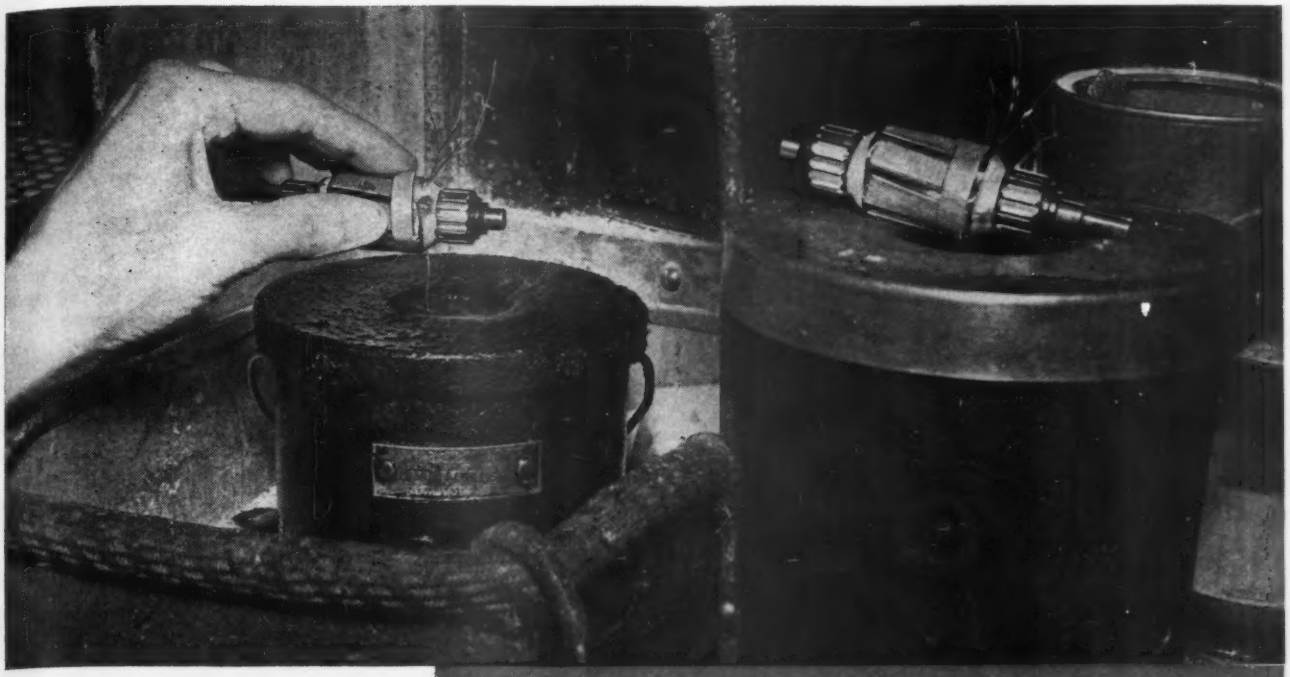


Fig. 2. Material is first dipped for 5 to 7 sec. in liquid "A" (left), then into liquid "B" (right) for about the same time.

steps as few and free from complications as possible; (b) speed, by making the operations as few and short as compatible with satisfactory results; and (c) minimum handling, necessary because the small size of the wire rendered it susceptible to damage.

Experiments showed that a two-step method was preferable for stripping the insulation. Two chemicals were finally selected, presently known as "A" and "B", each of which has a separate function. Material "A" is the starter, softening and loosening the insulation. Material "B" then dissolves and loosens the impregnated insulation, which would not have been susceptible before its condition had been changed by "A". The wire is left in a perfectly clean condition and is tinned by dipping immediately after the remnants of the insulation have been removed by the fingers of the operator. All operations are illustrated in the accompanying photos.

Process Available

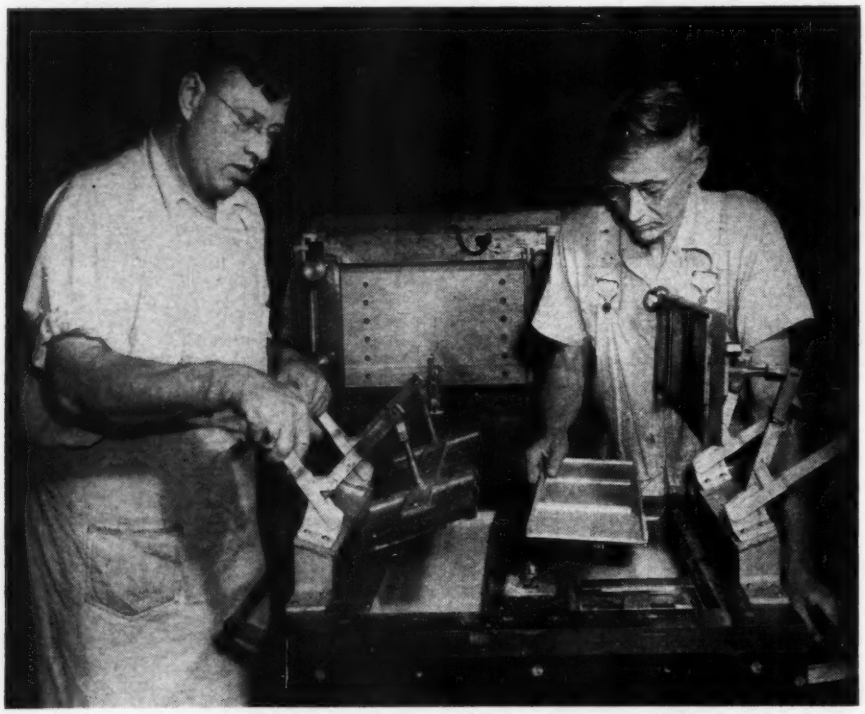
Temperature of "A" is kept at 425-450 deg. F. in an electricity heated pot. It is harmless to the operator; but since it gives off an unpleasant smoke, a vented hood is used over the container. The compound lasts for about four hours, after which it is thrown away and the pot cleaned thoroughly before refilling. It has been found that the method fails if the spent mixture is allowed to remain in the pot, which, however, does not have to be cooled to make the change.

Material "B" is a clear, colorless liquid, heated by a water bath to 120-140 deg. F. Higher temperatures speed the evaporation rate out of proportion to any increase in efficiency.

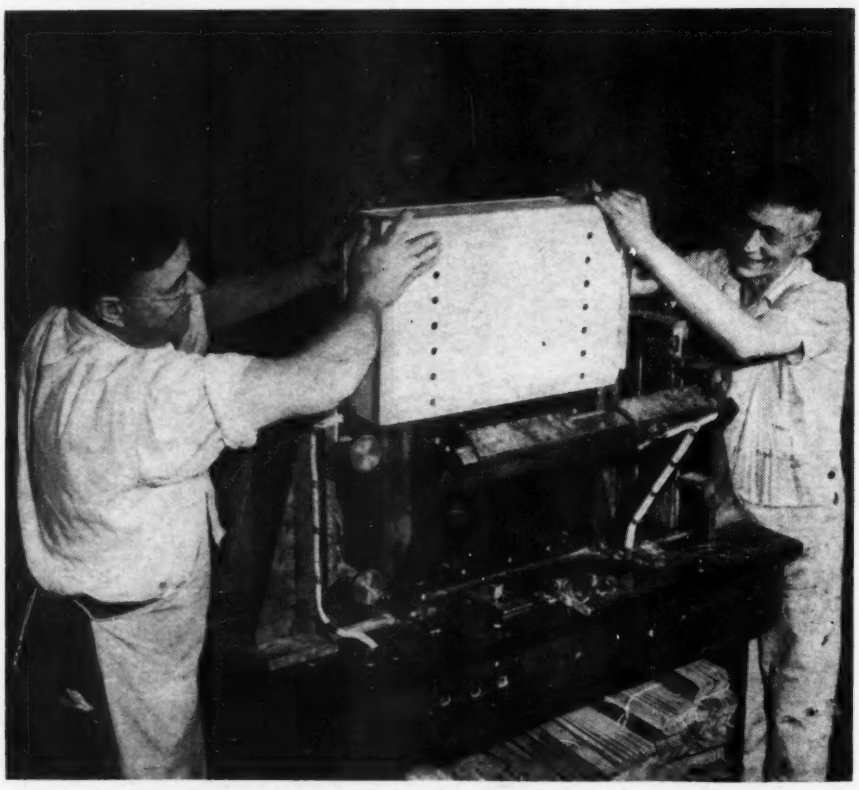
This process, originated by Fairchild for plant use, is patented; however, it is available for use by others who have similar problems.

Fig. 3. After removal from liquid "B", remains of insulation are removed by light rubbing with finger and thumb, and next operation is short tinning dip into solder. Complete process takes about ½ min.

PLANT-PRACTICE HIGHLIGHTS



Sides are first handled singly in flat type electric heater.



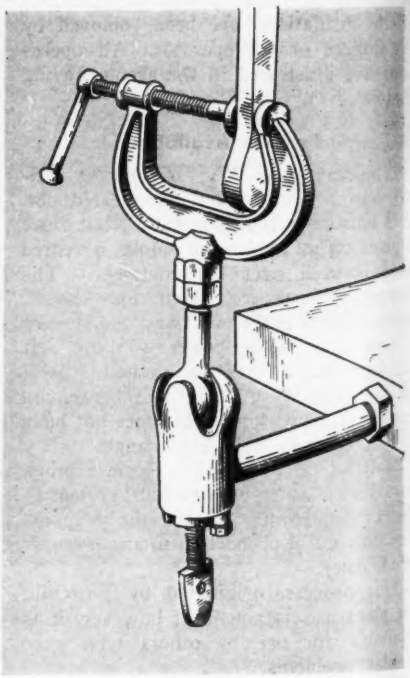
Assembled parts are baked in automatic heater resembling pop-up toaster.

Toaster Principle Speeds Gluing

• By employing same direct heating methods as employed in an electric toaster, Glenn L. Martin Co. states it has cut time for gluing wooden ammunition boxes from 3 hr. down to 15 min. Sides are first set singly in an appliance like an electric grill, then are assembled into finished box in a special device which operates like automatic pop-up toaster.

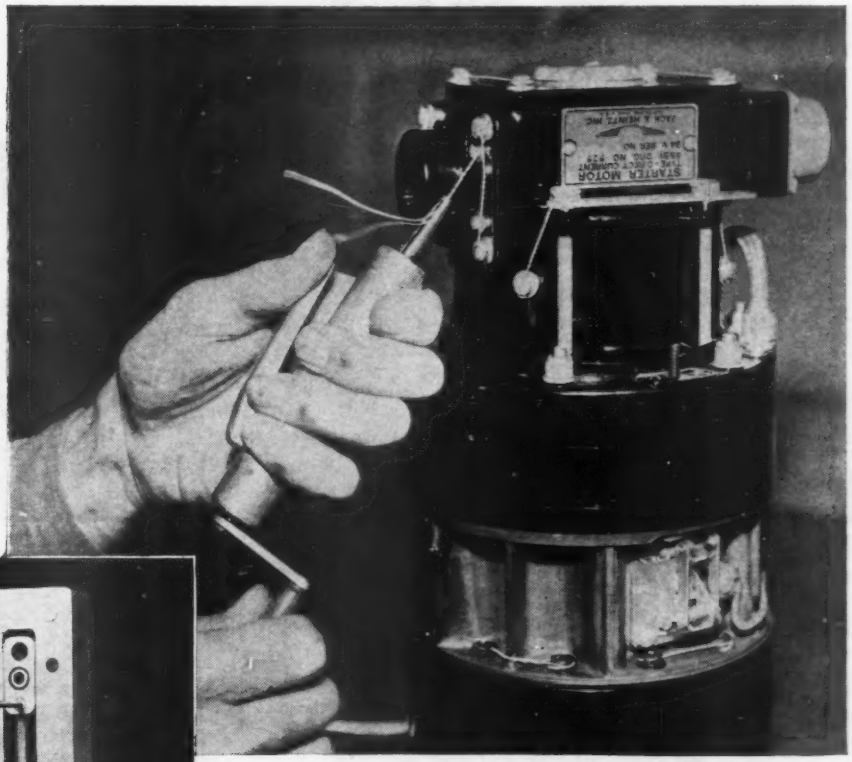
Part-Holder for Welding

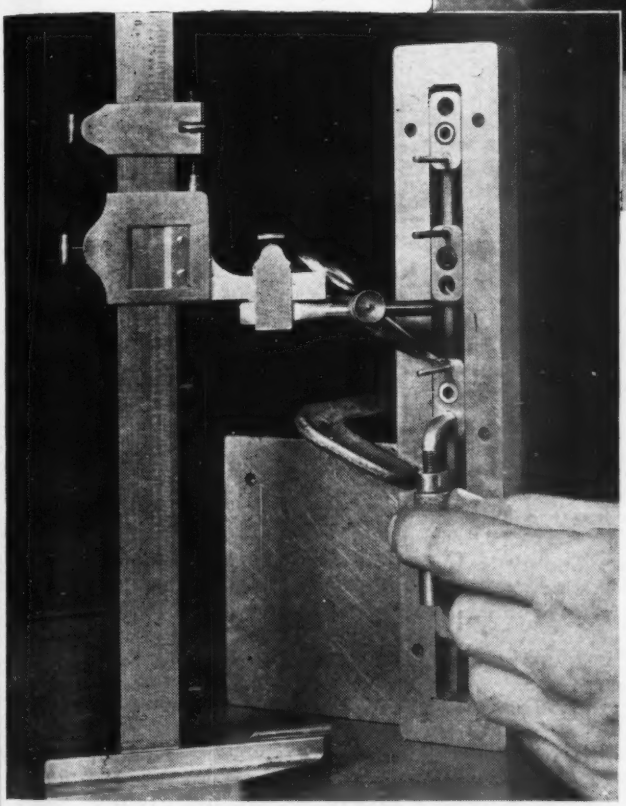
• Holding of small parts in position for welding has been simplified by this swivel clamp, developed in Curtiss-Wright St. Louis plant. Clamp is mounted on one end of shaft which has ball on other end. Ball permits easy movement of work in any direction. A pressure spring against ball prevents clamp from falling when screw is loosened.



Wire-Twisting Tool

• This safety-wire twister, developed from employee suggestion at Jack & Heintz, results in faster work and more even tension on wire. Tool consists of jaws, enclosed within cylinder, which are closed by gripping lever under thumb. Wire is then twisted by crank extending from end of handle. (Jack & Heintz photo.)



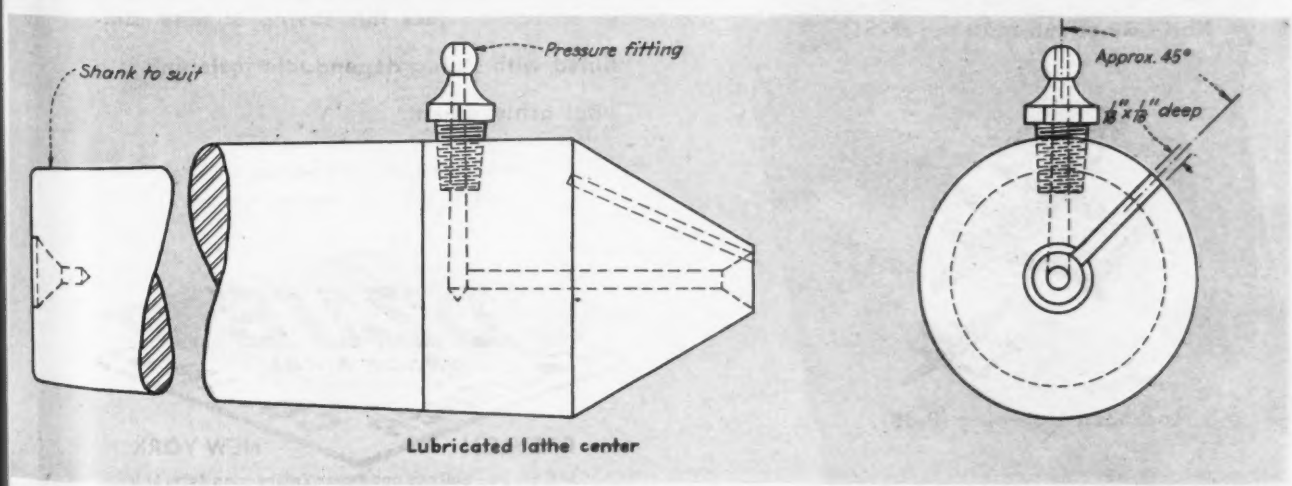


Certificate-Winning Drill Bar

• Here is adjustable drill bar which won Certificate of Individual Production Merit for Arthur Anderson of Northrop Aircraft's jig department. Note drill shanks extending, three in a row, from pilot guide holes in drill blocks. Bar is set up on milled block and dimensions established by height gage. Once dimension is held, bar will be unclamped and transferred to work. Micrometer adjustment takes last few thousands of an inch. Bar is capable of holding tolerances of .001. (Northrop Aircraft photo.)

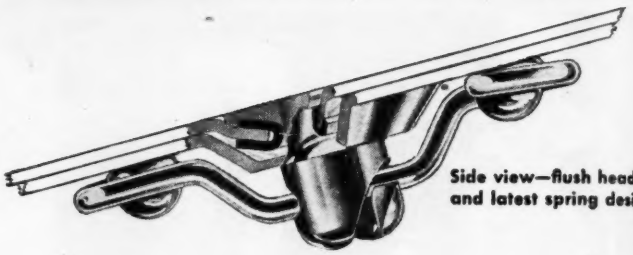
Lubricated Lathe Center

• Using a pressure gun to force lubricant round point of a lathe center to reduce wear, General Electric has devised way to do more accurate work faster, since point does not heat, nor does dirt collect on surface of cone. Groove on face of center distributes lubricant at point of lowest pressure, from which it is drawn around cone by motion of revolving work.



Lubricated lathe center

All five DZUS-equipped



Side view—flush head stud and latest spring design

Year after year the Dzus spiral slot fastener, keeping pace with the ever more rigid needs of the aviation industry, built a reputation as the most dependable fastener. Thus, today the five top U. S. fighters are *all* Dzus-equipped!

Speed is built into every inch of those planes—and into the Dzus Fastener too, Only a quarter turn—*click*—this dependable fastener is open or closed. No protruding parts to interfere or offer resistance. Every inspection station is quickly accessible. On the ground or on carrier deck this saving of time combined with strong dependable fastening is a vital achievement.

*The word DZUS is the registered trade mark of the Dzus Fastener Co., Inc.

DZUS TRADE MARK FASTENER CO., INC.

BABYLON NEW YORK

In Canada—Railway and Power Engineering Corp. Ltd.

A Plane Is as Fit As Its Finish

By JOHN BRENNAN and RALPH HALL
Paint Shop Foremen, American Export Airlines

Knowing that corrosion wins a quick victory when that finish isn't "right," AEA paint experts made a concentrated study of finish factors—and came up with a special technique which eliminates need for a priming coat.

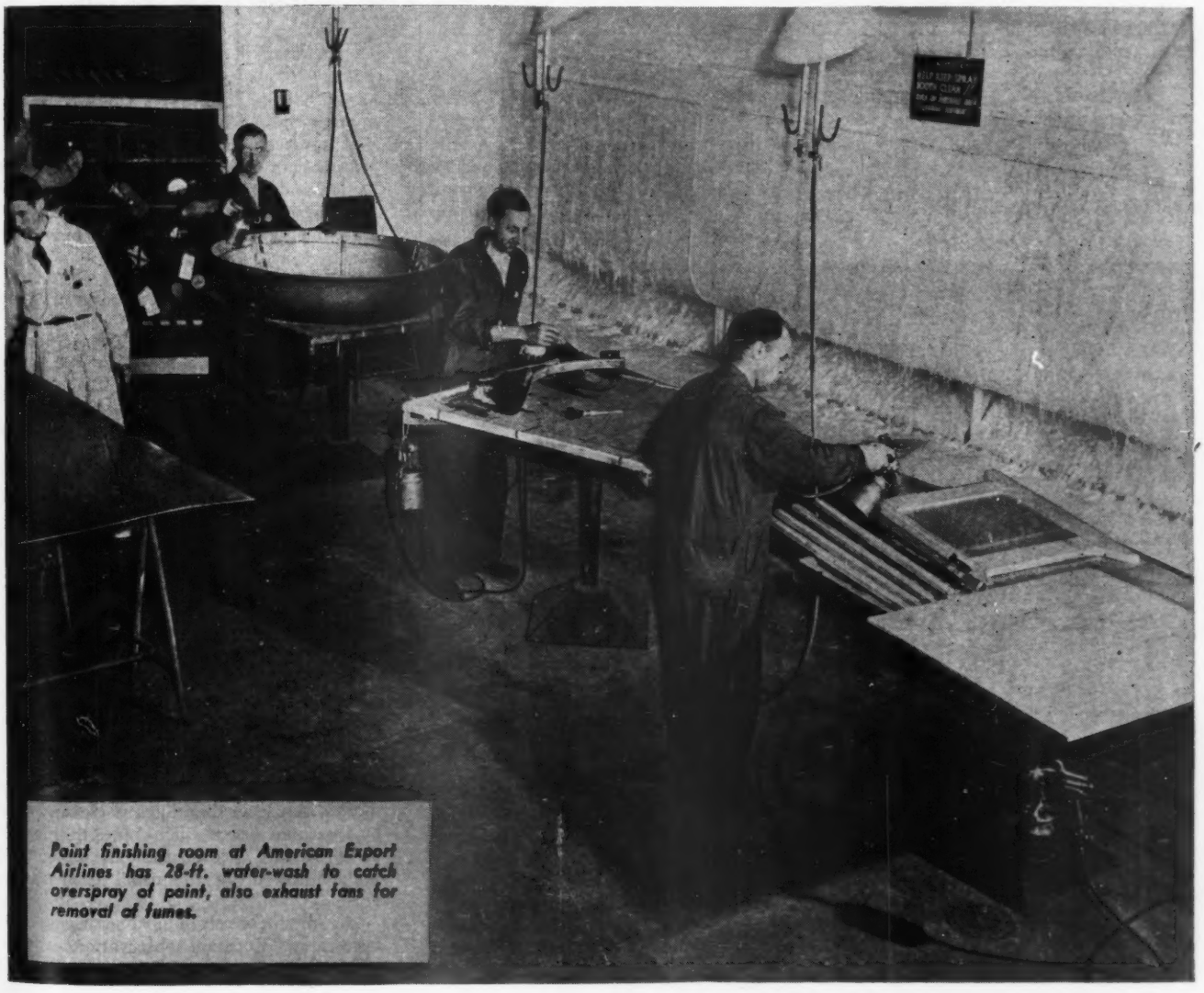
IT'S A BIG undertaking to maintain the finishes on a fleet of 30-ton flying boats such as are operated by American Export Airlines. In no other field of transportation, including the operation of land planes, do the forces of nature combine to break down and destroy the toughest organic coatings the chemist can devise.

During landings and takeoffs, salt water sluices over parts of a flying boat. Spray is picked up by the propellers and tossed back over the aircraft. In taxiing, the wing floats are almost submerged. A certain amount of this water does not completely drain off, and so, in the process of evaporation, a salt deposit remains. The presence of water is trouble enough, but crystalization means double trouble. This salt does not lie dormant. It is busy eating its way through the paint and, if left unchecked, eventually through the anodic coating.

The organic-finishing department of an airline has the proper materials to work with, but the proper *application* of these materials depends so much on the *preparation of the surface* to hold these materials that we at American Export Airlines devote more time and study to the surface preparation than to any other phase of the completed operation.

Surface Preparation

In preparing a surface on one of our Sikorsky VS-44 Flying Aces to receive and hold tight the organic coating, we endeavor to create a surface approxi-



Paint finishing room at American Export Airlines has 28-ft. water-wash to catch overspray of paint, also exhaust fans for removal of fumes.

mating as closely as possible the state in which the aluminum skin left the anodizing tanks after processing.

The amount of coating on the surface of any aircraft should be no thicker than is necessary to protect completely the metal against corrosion. Additional material serves no good purpose and many a bad one.

We have considerably decreased the amount of paint on the surfaces of our planes, reduced the corrosion problem, and lengthened the life of many parts of the aircraft which previously have required frequent servicing.

Battling corrosion—and it *is* a battle—calls for a definite understanding of what causes corrosion. If water or moisture could be kept from contact with metal, corrosion could not take place. The electrolytic action that induces corrosion takes place as soon as water touches unprotected metal. Where salt is present, the action is greatly accelerated.

The finisher's problem is to insulate the metal from all contact with water. The most common process in the aircraft field is by anodizing. This consists simply of applying a coating of aluminum oxide, which is actually a corrosive action. However, unlike nature's method for performing a process such as this, the finisher has in his control the means for arresting this action at a pre-determined point.

Further organic coatings on the anodic surface provide additional insurance and also serve the purposes of camouflage in war and decoration in peace, but they have necessitated a more careful watch of the sensitive aluminum hull for corrosion damage. Also, while on the ground or at the dock, the bare anodized surface presents a "patch quilt" effect. This is due to the fact that control of color in the anodizing process is not perfect. The result is that large skin areas may have no two portions exactly alike. Sometimes a protective coating of lanolin and beeswax has been applied over the anodized skins. However, this coating material has to be removed at servicing and again applied.

First step: Worker at right sprays water from gun while other man washes surface with soap and stiff brush. A third man follows up with water rinse.

It has been our experience that a paint coating can meet all requirements for protection and durability. But to accomplish this the greatest amount of consideration and time must be given to surface preparation.

Washing

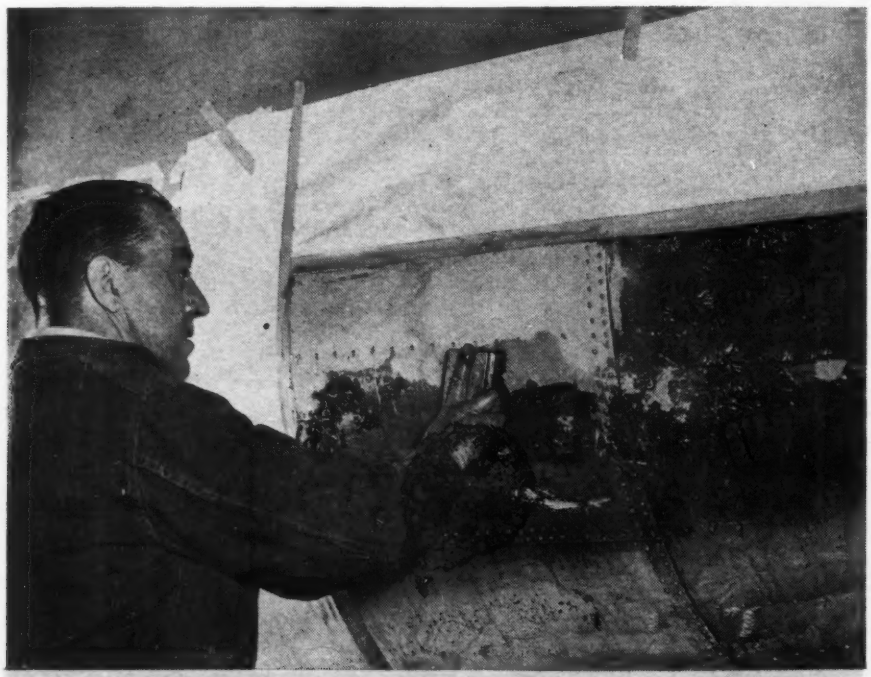
First mechanical operation in servicing one of our planes on arrival at its home base is a thorough washing. Hosing isn't adequate. We use a good grade of pretested soap solution applied to the surface by means of a pole gun. Agitation with stiff-bristled brushes follows, then a rinse with clear water, again with a pole-gun.

This equipment enables a team of three cleaners to wash 60 percent of the aircraft surface without the use of ladders, and it eliminates the use of rags and the gathering of lint and threads around rivet heads, seams, etc.

Particular attention is given to all control-surface hinge fittings, fairing places, floats and float fittings, and also to that portion which is closest to the painter's heart—the hull bottom. All surface salt deposits are removed by this operation.

After the floor boards have been removed, refuse in the bilges is cleaned out by a vacuum system, then comes the cleaning procedure used on the exterior of the hull, followed by the usual clear water rinse.

All of these cleaning operations are necessary. Constant observation of the results of the condensation that takes



Second step is stripping for close check of condition of surface. Painter's hands are coated to protect them from cleaning solution.

place in confined areas of all aircraft—such as the interior of hull, control surfaces, etc.—disclosed that *exterior corrosion is usually the result of an electrolytic action that begins on the interior.* Many man-hours expended in stripping paint from exterior surfaces have been saved as a result of our emphasis on cleanliness.

Extruding a compound fillet along all skin seams on the entire aircraft helped remarkably to lessen the amount of salt water settling on the interior of any part of our flying boats. For this purpose we have found a Neoprene compound very satisfactory.

Interior Surfaces First

If, after cleaning any localized interior surfaces, corrosion is evident, the area is stripped of paint, phosphotized with one of the standard preparations, touched up with zinc chromate primer, and followed with a coat of aluminum varnish (AN-TT-V-118).

The electrolytic action on interior surfaces, particularly the inside of the hulls, seems to intrude itself through flexing seams and rivets. Eventually, a firm grip is established and the exterior surface shows signs of deterioration. That is the reason we reverse the usual flying boat maintenance procedure and correct the interior first, the exterior last.

Our engineering department has discouraged the use of the standard aircraft fabric tape, which has been used so extensively around flight deck windows and also for sealing non-watertight fairings. This tape traps salt water and moisture, inducing corrosion, and presents a hazard in flight due to the flex of the surface and its tendency to become brittle and break loose. In place of tape, sealing compounds are carefully extruded into these locations. Incidentally, the man-hours consumed for servicing these areas has diminished considerably.

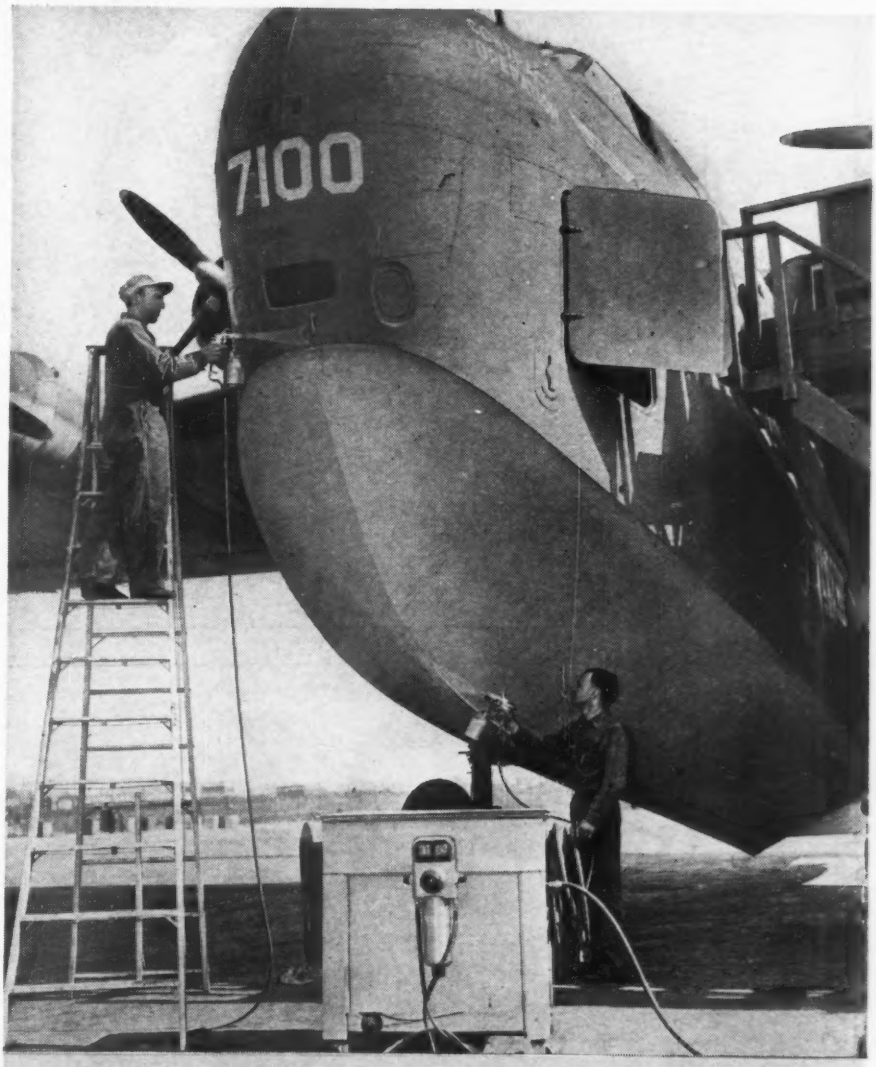
Here is the preparation procedure worked out at American Export Airlines: All external crystallized corrosion on hulls and hull bottoms is first removed with a stiff bristle brush and hot water. If the corrosion is in a more advanced state, then the paint is stripped and the corrosion removed with a solution of inhibited phosphoric acid. If, after this treatment, corrosion pits are still present, the inspection department should be consulted as to the airworthiness of the structure.

Stripping Paint

The paint remover used in our finishing department is similar to Navy specification C-113. It is a non-inflammable wax-free type which does not discolor or oxidize aluminum alloys. In stripping small areas, we apply this remover by brush. However, when large areas of the aircraft have to be stripped of all paint for a periodic check, the stripping material is sprayed on. We use a pressure tank because this permits the painter to apply the material at a very low pressure. A syphon-type spray gun is not recommended because most of the solvents in a

(*Turn to page 263*)

Next comes inspection to locate any possible local corrosion around rivets or in joints. Every rivet in bottom must be carefully checked before repainting.



Final process is repainting with synthetic enamel. Note special portable wagon carrying electric-drive pressure unit and transformer.

ATSC Tools Save Time, Equipment

Millions of man-hours and a wealth of equipment are being saved in AAF maintenance and repair by gadgets developed by members of the ATSC—the men on the ground who keep the planes in the air.

EVERY COMBAT FLYER, when he lands after a mission, gives full credit for his safe return to the ground crews who maintain and overhaul his plane—for he knows that their skill and careful work keep him in the air until he wishes to land.

But few pilots, and virtually no one outside the ATSC, can realize how many times combat planes, which now fly regularly, would be grounded, if it were not for the ingenuity of the mechanics. They do not merely service the machines but also devise and make tools which save working time and equipment. Often, as

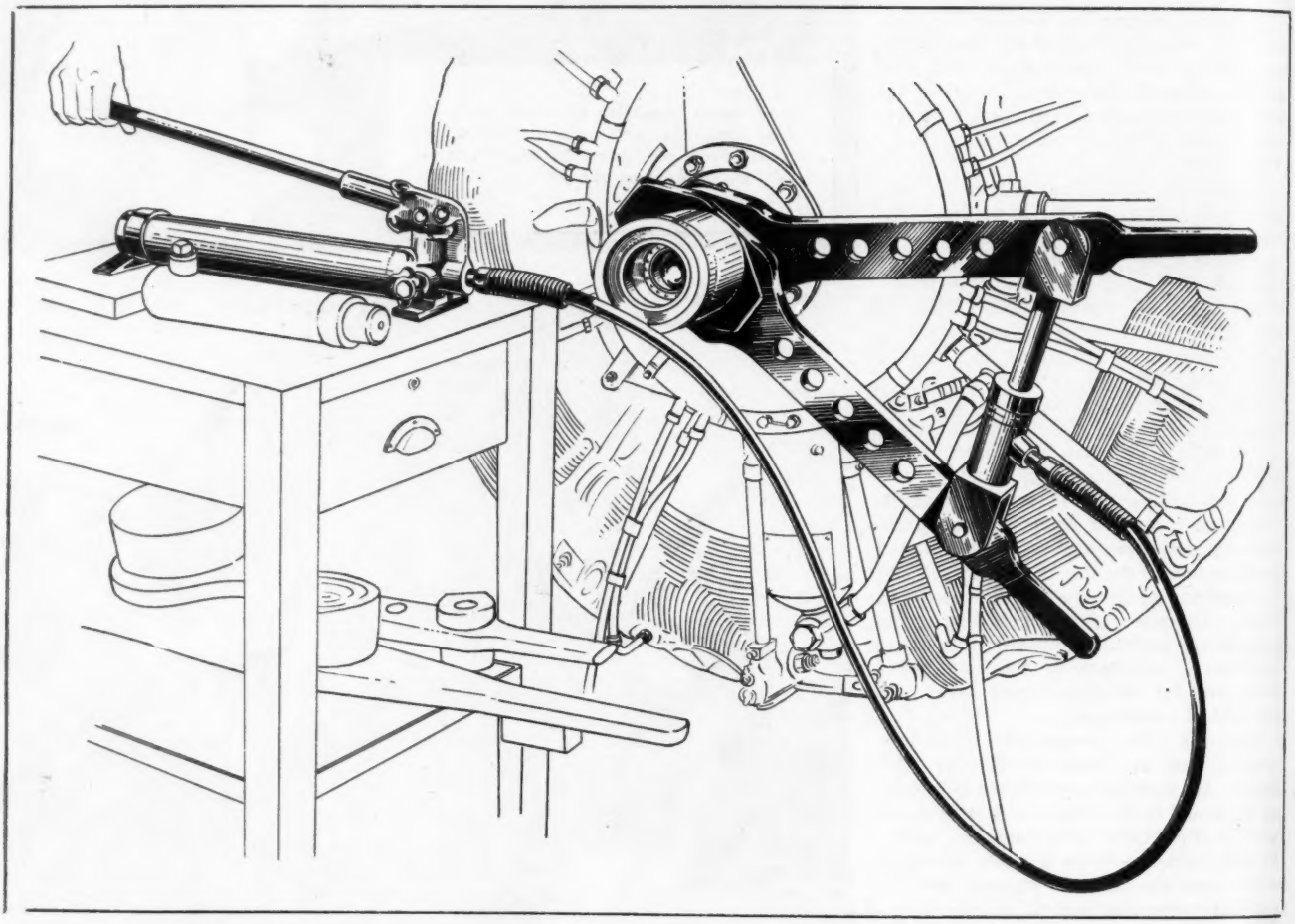


Fig. 1. By using hand pump at left, 7-ton jack between wrenches is expanded, forcing them apart and breaking loose propeller-shaft thrust nut.

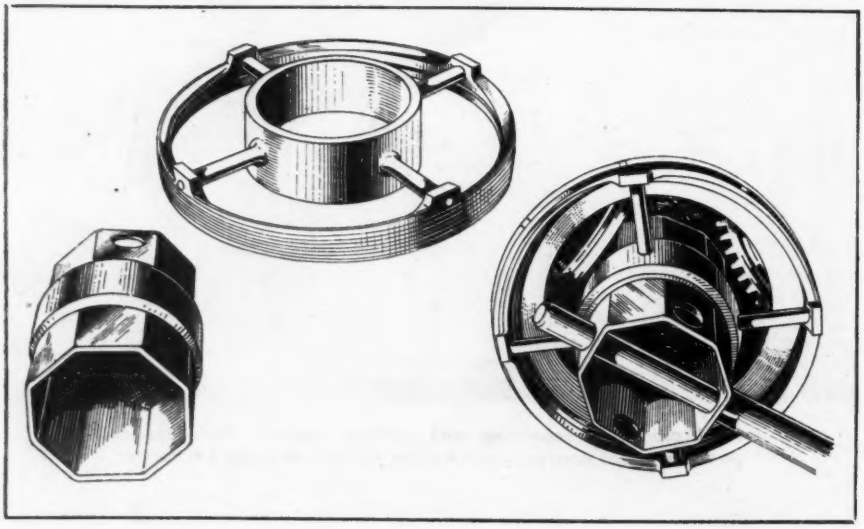


Fig. 2. Propeller-hub retaining-nut wrench (upper left) didn't slip after guide (right) was made from dome nut and applied as shown (bottom right).

a result, they thus augment the fighting strength of our air arm.

By combining two wrenches with a modified 7-ton jack (Fig.1.), P. P. Baker and James Farrow, of Ogden ATSC, have simplified the job of removing propeller shaft thrust nuts so that sufficient pressure can be exerted by one hand where formerly sledge hammers were used—to the detriment of the wrenches and often with serious injuries to personnel.

At San Antonio ATSC, Karl Buechler, noticed that much time was wasted because the standard propeller-hub retaining-nut wrench frequently slipped off. To eliminate this trouble he made the guide shown in Fig. 2. using a Hydromatic

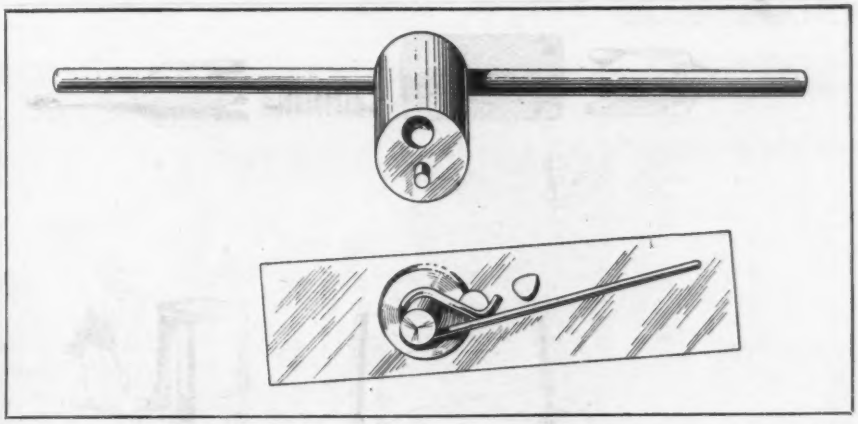


Fig. 3. This jig can bend cowling safety pins faster than they can be used. Operated by a turn of the wrist, jig forms an indispensable part of a shop's equipment.

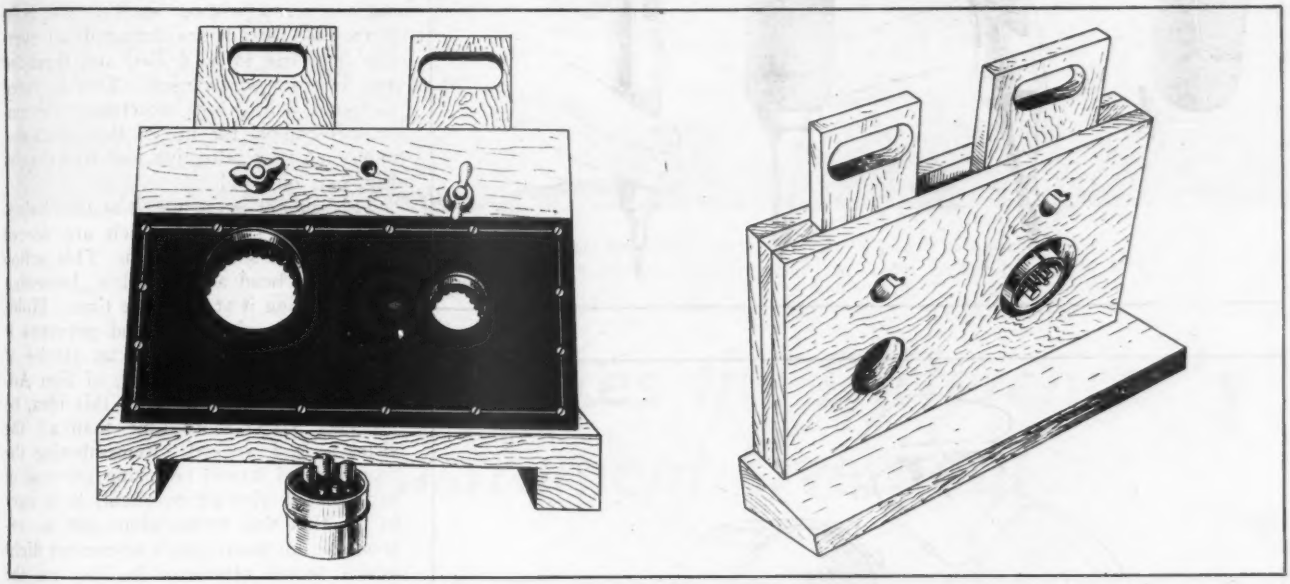


Fig. 4. Delicate Cannon plug (left foreground) was formerly held in vise when wiring—frequently with disastrous results. Clamp illustrated above holds large or small sizes and speeds work.

dome nut and pieces of scrap. Result was a 25 percent saving in time and longer life for the wrench, which formerly was damaged by slipping. Picture shows the nut at top left, guide at right and the whole in use at bottom. A band was welded round the socket to fit the guide.

When a cowling safety pin is lost and none can be had without a requisition, a lot of time is saved when the jig shown in Fig. 3 is on hand. By placing a length of wire in this device and giving the handle a half turn, a new pin is made in less time than would be needed to write down the need. For rapid production of stock, this jig saves much time in a busy shop. Felix D. Flowers, of Sacramento ATSC, gets the credit for this device.

A junior electrician, E. B. Butler, also of Sacramenta ATSC, disliked the idea of placing delicate Cannon plugs in a vise when wiring them. Working with P. E. June, a carpenter, he made the holder shown in Fig. 4—and thereafter no more plugs were damaged. In addition, wiring time was cut in half and a better job was done.

Though heavy steel cable is not used on aircraft, there are unfortunately, wreck-

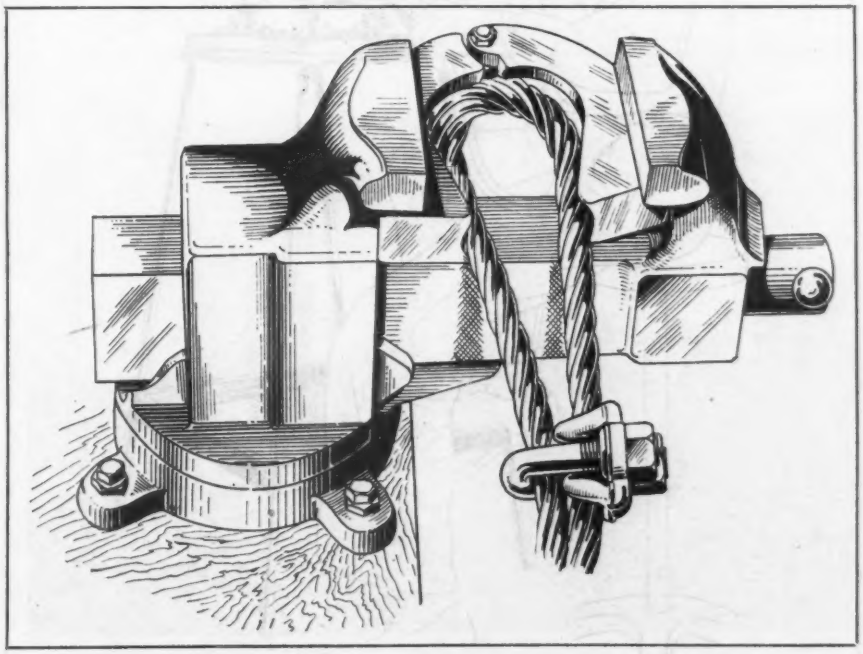


Fig. 5. Vise-operated cable clamp bends heavy cable and also holds it firmly while being clipped.

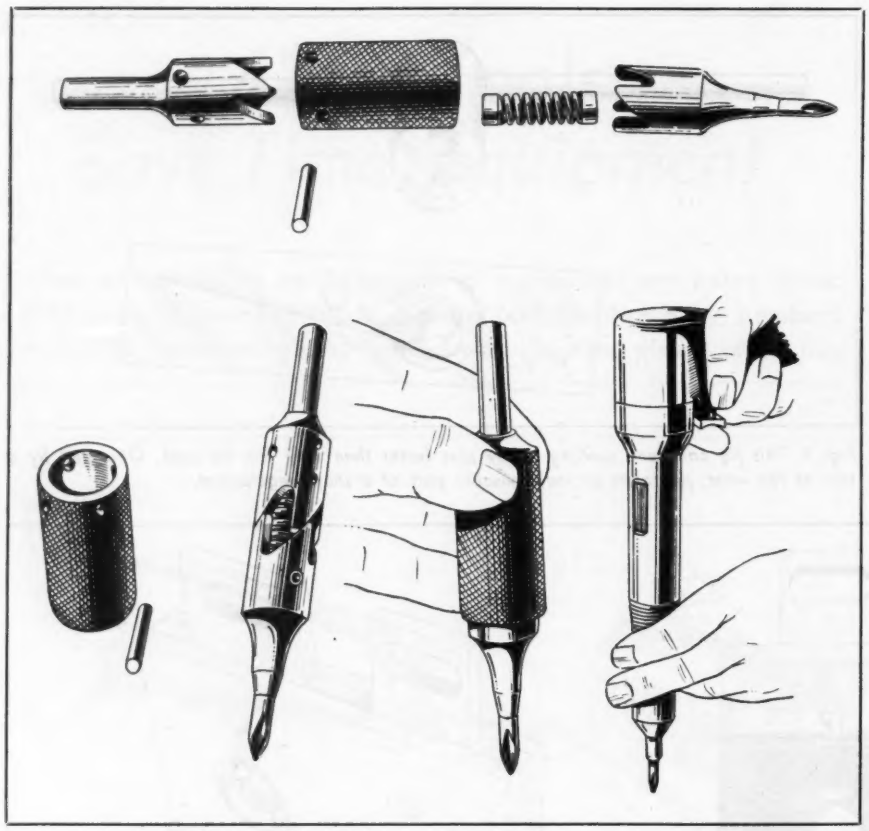
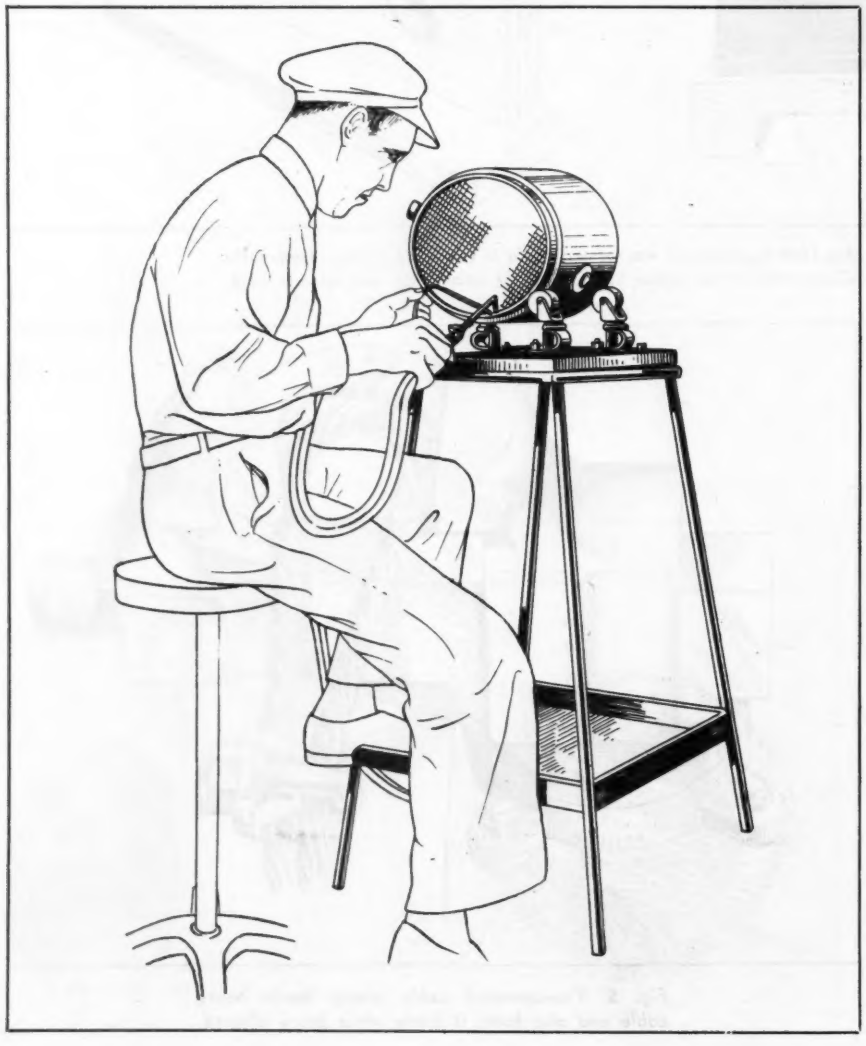


Fig. 6. Screw loosener is one of greatest time savers. Action of two helical parts working together jars and twists even the worst corroded screws without damaging them.

ing cranes to be maintained. Clipping the cables is a long, hard job, chiefly because of the stiffness of the material. N. Maloof, another Sacremento mechanic, built the clamp illustrated in Fig. 5, which both bent and held the loop until the clamps were attached.

A corroded screw is one of the small things which wastes a lot of time when it must be removed. Ordinary screwdrivers either split the head or slip and cut it to pieces. Next stage is to drill out the screw without spoiling the hole. If the hole threads are damaged, an oversize hole has to be drilled and threaded and a larger screw used. This is rated as poor work, but sometimes circumstances compel the use of this method—unless a screw removing tool like that in Fig. 6 is on hand.

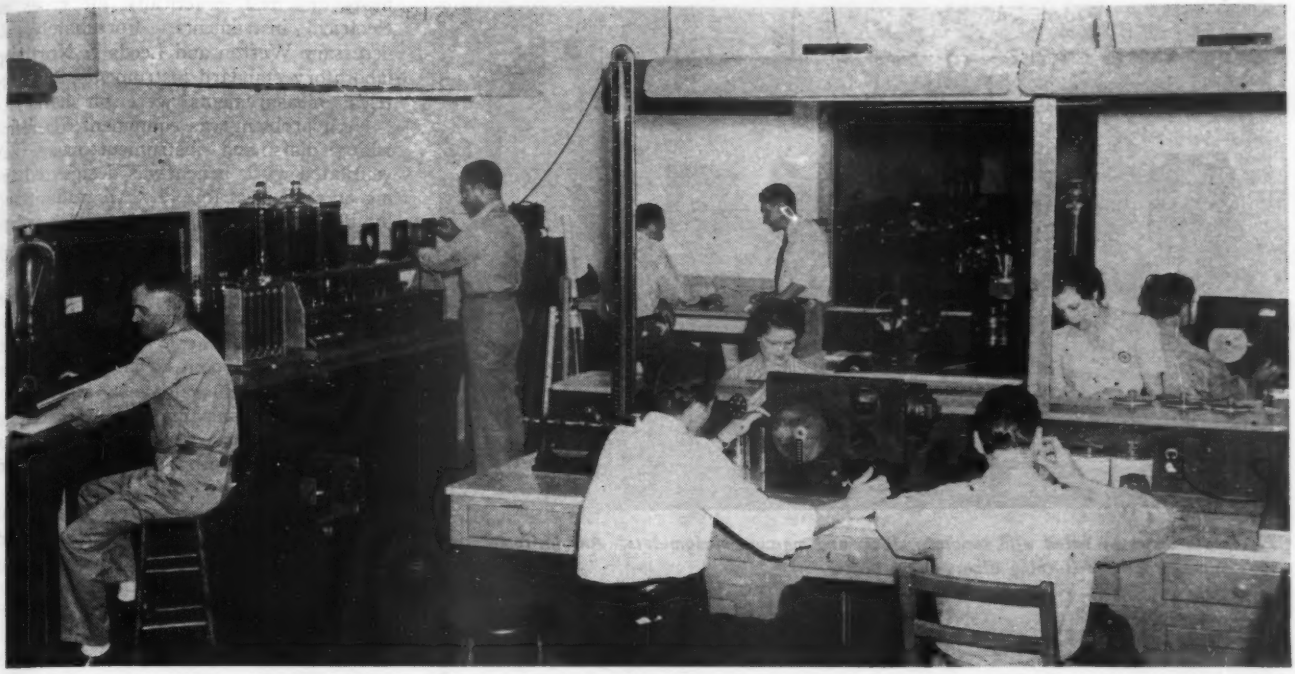
This gadget is composed of two halves with helical surfaces, which are forced together by a small air gun. This action strikes the head a sharp blow, loosening it and turning it at the same time. Holding the tool with one hand prevents it turning backwards on the up stroke of the gun. When J. M. Hill, of San Antonio ATSC, came up with this idea, he probably saved more time than all the years he had worked. Remembering the thousands of screws requiring removal of each major aircraft overhaul, it is easy to see that this device alone can be responsible for many hours of combat flight which would otherwise be lost on the ground.



At San Bernadino ATSC they repair a lot of circular radiators—which are not of a convenient shape to handle. Blocking them to prevent rolling is a time consuming job, so H. E. Goodwin figured out the stand shown in Fig. 7, where the radiator rests on rollers, making it easy to turn and firm when being worked upon. Not only are the radiators put back in service sooner, but none are damaged by rolling about on the old fashioned bench.

These examples do not pretend to cover, even slightly, the various activities of the ground crews in the ATSC. With over a million men on the ground, this branch of the armed forces could claim, without much chance for contradiction, that it possesses enough inventive brainpower to supply several major industries, with plenty to spare. What is even more important at this time, they are keeping the largest airforce the world has ever seen in the air, where it belongs.

Fig. 7. Circular radiators can be conveniently repaired on this roller bench. Time is saved and damage risk eliminated, while valuable bench surface is made available for other work.



Part of Embry-Riddle Instrument overhaul department. Scoresby is seen in left background, while in foreground are tachometer test stand and water manometer.

SYSTEM Makes the Difference In Instrument Overhaul

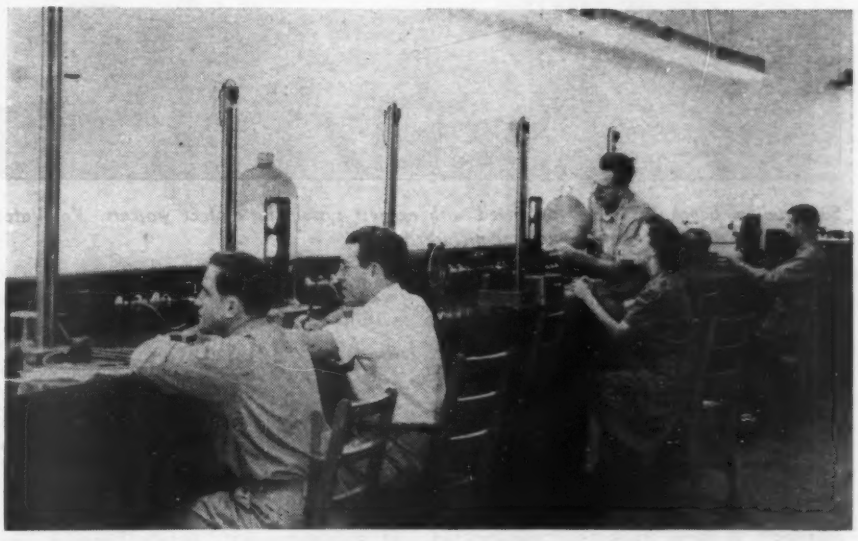
By installing up-to-the-minute overhaul equipment and keying operations to a scientific production flow, Embry-Riddle adjusts instruments more accurately and returns them to duty in less time.

CONSTRUCTION of the instrument department at the Embry-Riddle Co. was begun in the latter part of 1942 in a concrete building providing a floor space of approximately 4,000 sq. ft.

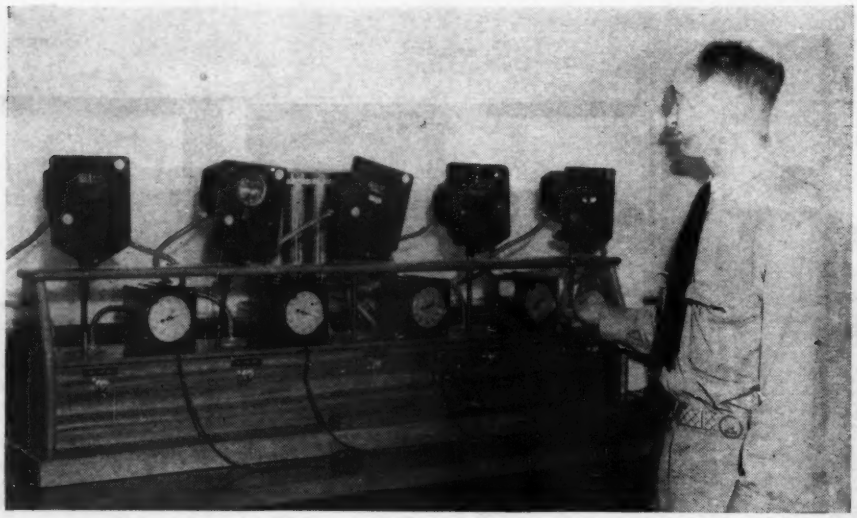
To protect the delicate mechanisms the department was equipped with air conditioning and humidity control, eliminating dust and reducing problems caused by perspiration from the technicians hands. Dust in bearings will, of course, cause rapid wear and early failure of an instrument, and the various acids and salts exuded by sweat pores of the technicians will corrode metal parts. To guard further against dust, the floor was covered with asphalt tile, which is carefully kept waxed and polished.

Procurement of furniture and equipment being next to impossible, a special projects department was created to build the furniture, fixtures, and tools of the instrument overhaul department. Here, the first project was to construct cabinet-type work benches for 45 technicians per shift. Each bench, built of solid mahogany, featured a brown Formica top having white Formica disks inlaid directly in front of each position.

Each bench accommodates four workers, and all operations are done on the white disks, which make it easy to see small screws and parts. The benches are



Five manometers being used for testing pressure instruments. In center is pressure chamber for altitude tests, while at far end is tachometer tester.



Five-place Scoresby fitted with separate clocks and mercury manometers. Any instrument may be stopped without disturbing others being tested.

Safe radium bench has glass top fitted with exhaust system to protect workers. Ventilated glass drying racks are shown at left of picture.

piped for air pressure, and each has dusting and drying guns conveniently located. Chairs were equipped with fiber swivel casters so that they could be easily moved with a minimum of noise.

At this point trouble started. A four-cylinder air compressor of ample capacity had been secured, but no suitable vacuum pump could be found. Special projects came to the rescue in a rather unorthodox manner. A large tank was constructed and hooked up to the intake or low pressure side of the compressor. The tank was fitted with adjustable intake valves within a filter, set to hold the pressure in the tank at 10 in. of mercury. Air enters this tank in a continuous flow, and it passes through the compressor into the pressure tank where a head of 40 psi. is maintained, so that both vacuum and pressure lines are supplied by the one compressor.

Test benches likewise were constructed of mahogany with brown Formica tops, and black Bakelite instrument panels are ranged along the back of each bench. Two of these benches, each 10 ft. long, contain all necessary equipment to calibrate and test practically all types of electrical instruments. Fortunately, all necessary Weston and Leeds & Northrop laboratory standard instruments for electrical measurements were on hand.

Next problem was equipment for refinishing dials and instrument cases. A ventilated work bench was designed having an exhaust manifold. All radium and luminous paint is applied under plate glass, the fumes being carried away through the exhaust. Special jigs and fixtures were constructed to hold the various items in the most convenient position. This equipment is housed in an air conditioned room, separate from the main overhaul laboratory. An air conditioned case-refinishing and dial-painting room, next to the radium room, contains a paint spray booth with turntable and an oven for baking dials and cases.

Formica-top mahogany test benches 10 ft. long were next built, each equipped with two sets of high and low vacuum outlets, two pressure outlets, and four 110v. a.c. outlets. All valves are chrome plated, and engraved plates are used for identification. All test benches may be vibrated so that tests may proceed under simulated operating conditions.

Three small and one large glass-front pressure chambers were next constructed. The small chambers have a capacity of 3 instruments, and the large one 18. All chambers, may be vibrated and pressures controlled at levels either above or below that of the atmosphere.

A single place Scoresby constructed to test bearings, roll, pitch, and yaw soon became a bottleneck. Special projects came to the rescue with a five-place Scoresby so constructed that one instrument may be removed or held stationary, to check drift and various headings, without affecting the others. There are five stop clocks and five mercury monometers register operating pressures.

Women work efficiently at instrument testing and assembly. Small parts are easily visible on white Formica working-disk which, by providing focal point, tends to reduce scattering of pieces.

A magnet charger was required that would charge all types of magnets used in instruments and generators. Magnets are charged to the maximum degree and after installation are drawn down to the desired point by use of a Variac in conjunction with demagnetizing coils.

Various discarded aircraft parts, a mixer motor, and other odd parts, were mounted on a mahogany base, and the result was an excellent shake table to test instruments under varying conditions of vibration.

For compass filling, a battery of five size C bell jars were mounted inverted in line on a mahogany base, each having a Bakelite disk cover equipped with a shutoff valve and connected by a rubber hose to a vacuum manifold. With this equipment, five compasses may be filled with compass liquid simultaneously, and any one may be removed or replaced without disturbing the others.

Variable speed tachometer run-in stands each having a capacity of eight

Final assembly is performed on well-lighted benches installed at efficient eye-level working height. White disks again aid in concentrating work.

instruments were constructed, as were several tachometer test stands with built-in stroboscopes. The latter will handle both electrical and mechanical tachometers.

When a low-temperature instrument check was needed an insulated dry ice refrigerated cabinet with window was constructed to enclose one of the pressure chambers in which temperatures as low as minus 60 deg. F. are obtained.

Other items furnished by the special projects department include units for hand rotor balancing and open case calibrating fixtures for gyro instruments, miscellaneous special wrenches, tools, 90-deg. geared screw drivers, improved bearing pullers, special taps, special lathe chucks, gyro rotor chucks, mercury and water manometers, vacuum boxes, inclinometers, etc. An Orsat was purchased for analyzing

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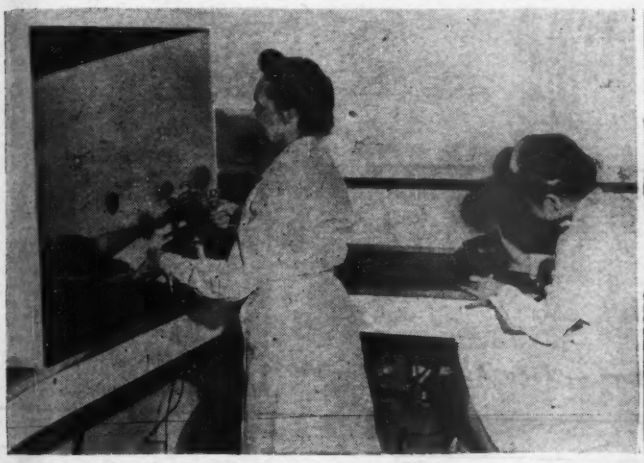
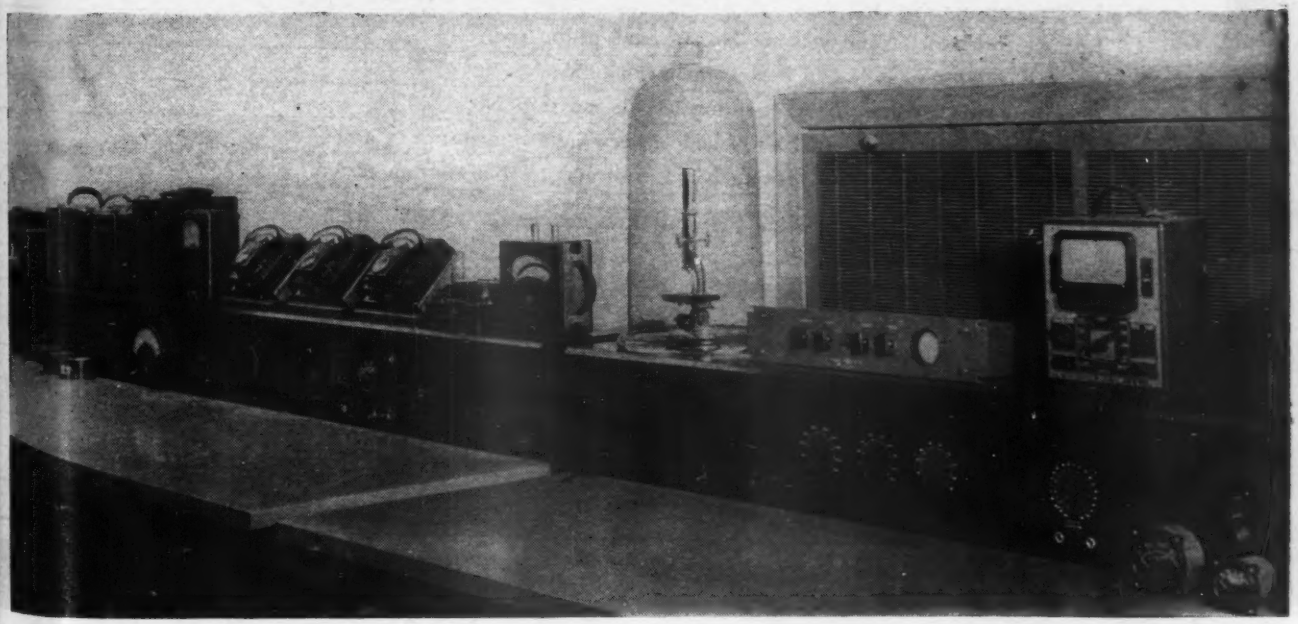


Final step in overhaul is spraying of finished instruments. Spray booth at left is fitted with turntable, and exhaust fan carries off fumes.

This stroboscope was designed and built by Embry-Riddle when shortage of standard instruments prevented obtaining of such units from manufacturer.

Bench equipped with laboratory standards for calibration, which are employed instead of master instruments. This method is stated to give closer accuracy.



CUSTOMER SERVICE DIVISION

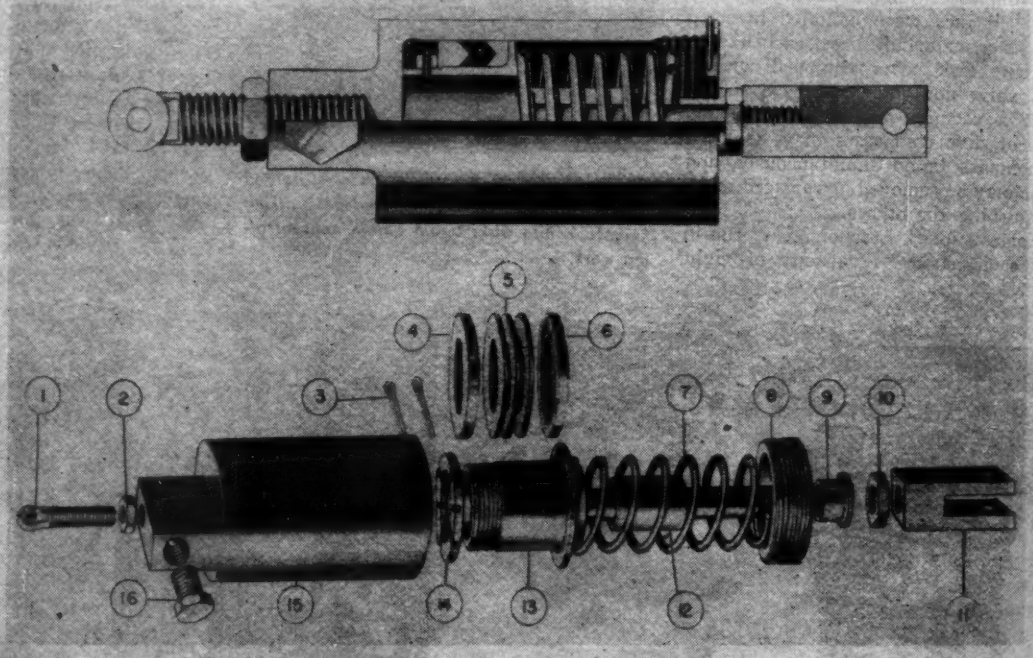
LOCKHEED AIRCRAFT CORPORATION

MODEL _____ LICENSE _____ OWNER _____

SERIAL _____ LOG BOOK TIME _____ ADDRESS _____

LOCATION _____ WORK ORDER NO. _____ DATE _____

SERIAL NO. UNIT _____



Landing Gear Up Lock — Vega Assembly No. 19054

Disassembly: Dept. No. ( )

Special Tools Required:

1. Retaining Ring Tool No. S-31200.

Disassembly: Time — 15 Minutes

1. Loosen jam nut No. 10.
2. Remove fork No. 11 and jam nut No. 10 from piston rod.
3. Remove cotter key No. 3 and remove retainer No. 8.
4. Remove piston assembly No. 13, spring No. 7, and stop No. 12.
5. Remove cotter pin from nut No. 14 and unscrew nut from piston.
6. Remove adapter No. 4 and packing No. 5, also adapter No. 6 from piston.

Disassembled by:

INSPECTION AND OVERHAUL — DEPT. NO. ( )

Item	Part	Part No.	Inspection and Overhaul Req.	Instructions
1	Bolt	11735		
2	Nut	AN316-7R		
3	Cotter	AN380-2-2		
4	Adapter	11744	Scratches, wear, etc.	
5	Garlock Packing	AN6225-20	Wear and fraying	
6	Adapter	11745	Scratches, wear, etc.	
7	Spring	11743	Alignment and condition	
8	Retainer	11736		
9	Bushing	11739	Scratches and wear	
10	Nut	AN316-5R		
11	Fork	11738		
12	Stop	11740		
13	Piston	11741		
14	Nut	11737		
15	Cylinder	11742	Scratches, wear and damage	
				Time — 10 Minutes
			Overhauled by:	Inspector:

ssembly: Dept. No. ( )

eassembly: Time — 15 Minutes

1. Reverse of disassembly:
2. Assemble this unit wet with hydraulic fluid. Make sure the piston retainer nut No. 8 is drawn up flush with cylinder No. 15 and properly safetied with cotter No. 3.

Assembled by:

unctional Test: Dept. No. ( )

st: Time — 5 Minutes

1. Connect the up lock cylinder to hydraulic test equipment and pump pressure to 1000 P.S.I. Check for leaks.

Inspector:

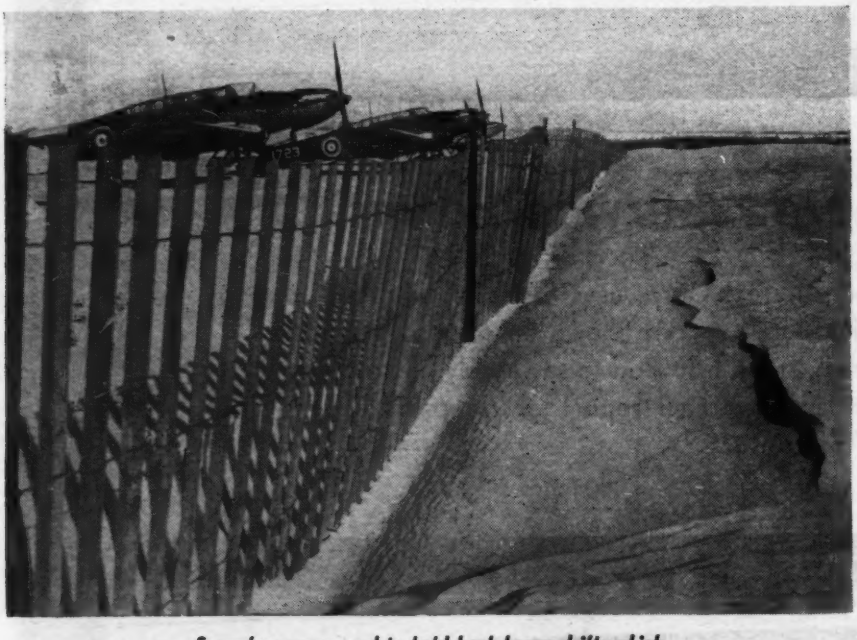
Lockheed's New Service Forms

Service division of Lockheed Aircraft Corp. uses forms of this type for recording overhaul and maintenance work. Shown on opposite page is form comprising job diagram, tool list, and disassembly instructions, while herewith is inspection and overhaul report giving parts list, re-assembly instructions, and test data.

Snow Doesn't Ground RCAF

Problem of reaching flying speed in a foot of snow made effective snow treatment essential for RCAF. (RCAF photos)

Each year in Canada, General Snow threatens to flank Dominion aviation with his usual white barrage. But Royal Canadian Air Force tactics regularly rout the General. Here's how—



Snow fences are used to hold back heavy drifts which otherwise would make takeoffs almost impossible.

TO KEEP ITS AIRCRAFT in operation throughout the winter, the RCAF has developed standard instructions to meet the snow problem at all fields, in this way being able to maintain the vast training problem of the British Commonwealth Air Training Plan. Little time is lost through snowfalls, with aircraft using cleared or compacted runways a few hours after a storm.

Methods are dependent on whether the airfield is in the heavy showbelt or in more southern sections where snow does not lie throughout the winter. In heavy snowfall areas, compacting does the trick, each fall of snow being rolled into the previous layer, 1 ft. of snow being packed down to 3 in. In light precipitation areas, snow is removed entirely from the runways. In both cases, wheeled aircraft can now be used the year 'round.

Where complete or partial snow removal is carried out, one-way snow plows are used as soon as 1 to 2 in. of snow has fallen. The starting swath is down the center of the runways, then there is continuous working of the snow to each side. An early start often eliminates the use of a snowblower. To save burying marker lights, one or two trips are made on the outer edge of the runway, forcing the snow towards the center.

When blowers are used, the RCAF recommends that snow be blown at least 100 ft. from the runway and that rollers be used to consolidate it enough to sup-

port an airplane. Snow banking up along the edge of the runway must be cut down to remove a hazard to wing tips.

Basic idea in compacting snow by rolling and dragging is to build a paving of snow which may eventually become ice on which planes can land and take off readily. It is recommended only when average temperatures are low enough to insure that occasional thaws will not cause disintegration. This method has increased flying by as much as 400 percent at some fields.

The initial packing is by far the most important step in obtaining a satisfactory runway, since this forms a foundation for future surfaces by cementing the snow firmly to the ground. It should be started as soon as 2 or 3 in. of snow has fallen and continued until the storm has stopped. The field should only be rolled once after each snowfall. Further rolling has a tendency to pulverize not only the new snow but the former surface as well.

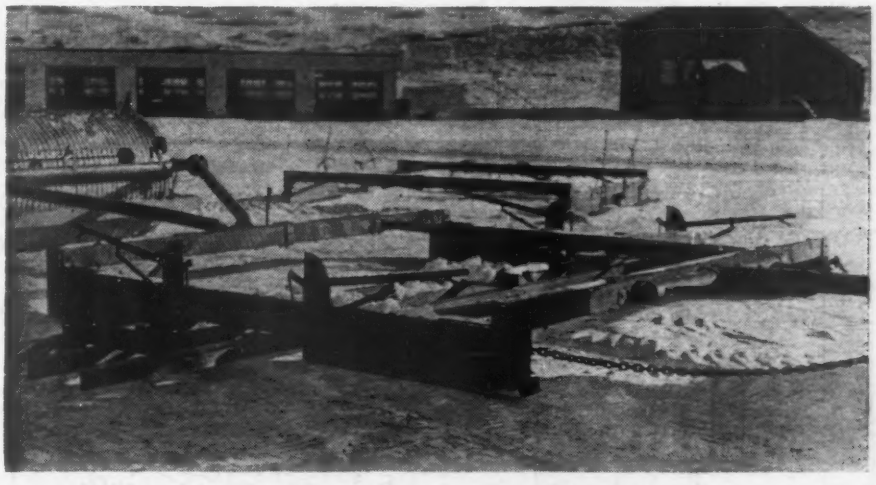
Heavy snowfalls usually have to be rolled and dragged after the first rolling has frozen. Uneven surfaces can be levelled off by using a drag ahead of the rollers to shave off high spots and fill low ones. A drag also helps to press air out of light fluffy snow.

When a rise in temperature softens the surface, the airfield must also be rolled to compact the snow, starting late in the day when the temperature is falling. A properly compacted surface usually does not honeycomb like ice on a lake, during the spring thaw, if rolling is continued. In the spring break-up, as much as possible of the compacted snow should be removed. When the surface goes completely rotten, all snow may be removed with snow blowing equipment. Slush should be blown far from runways because a sudden freeze would make a mass of ice which would be very hazardous prior to another thaw.

Corrugated gang rollers are used by the RCAF in sets of three. They are

(*Turn to page* 293)

Rotary snowplow chops up snow and blows it clear of runways.



Drag followed by roller. This equipment is used when snowfall is not too heavy to impede its ready operation.

Where snow is too deep for removal, it is rolled down into a hard, compact surface. Runways are marked by evergreens.

Quick-Disconnect Simplifies Battery Changes

By DON DAVIS, Cannon Electric Development Co.

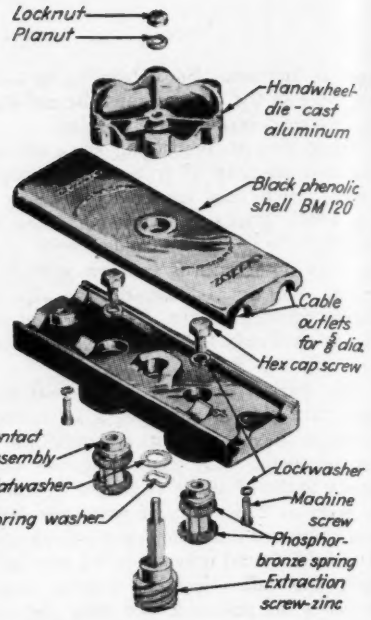
Heartily welcomed by maintenance crews stationed at sub-Arctic airfields, this invention enables two field men to replace aircraft batteries in much faster time—and without removing their gloves.

THIS DEVICE which eliminates certain field problems encountered with the current type of battery fitting, is being rapidly installed in new aircraft.

The former method of disconnecting aircraft batteries consisted of placing the cables on two stud terminals in a box on the side of the battery. Wing nuts were used to hold the cable on the studs. To disconnect the batteries, it was necessary to take apart two long screws to remove the cover, exposing the stud terminal.

In sub-Arctic regions, experience has proved that it is extremely difficult for the maintenance man to remove these wing nuts while wearing heavy gloves necessary in such climate. Moreover, sub-freezing temperatures require more frequent battery changes. This process was slow and cumbersome, particularly under combat conditions.

After the protecting box was removed for disconnection of the cables, the terminals left unprotected presented the danger of shorting the battery if any metal object touched the terminals. In numerous instances, such contact caused the current to burn holes in the aluminum structure during the removal of the battery.



Exploded view of parts of Cannon battery plug.

Based on the screw-jack principle found in many connectors, the new fitting described here speeds removal and banishes shorting and fire hazards.

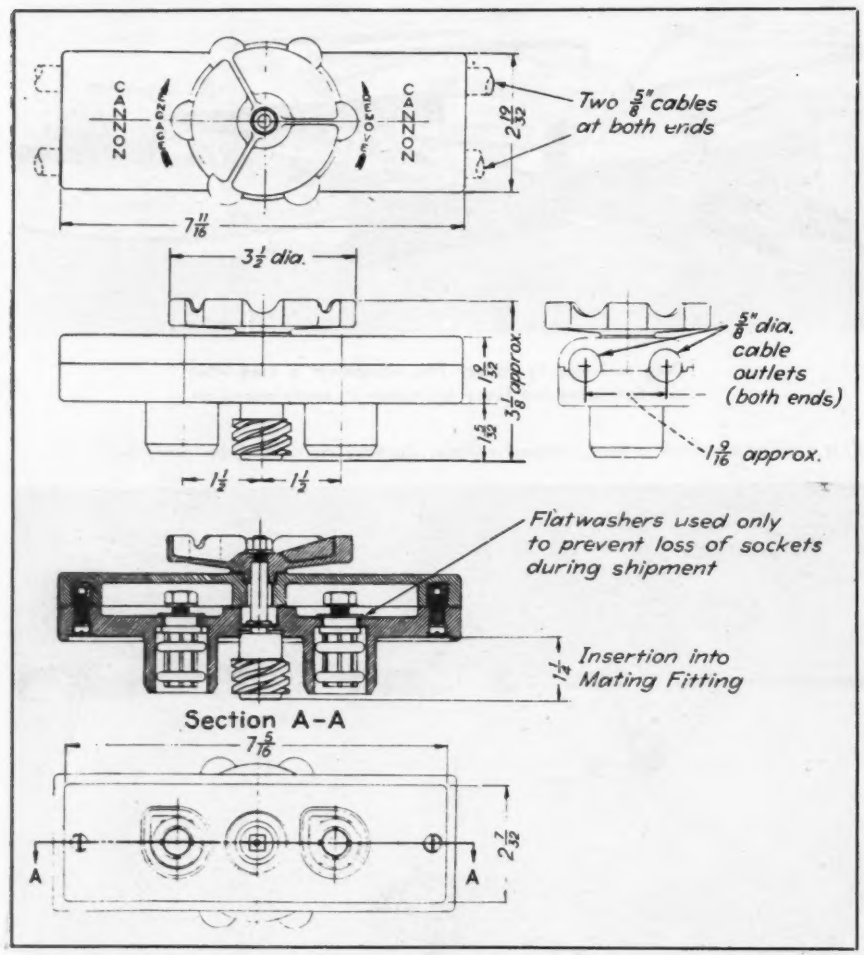
The wheel that turns the gear which engages and disengages the plug (with contacts) is large and notched to be operated easily by a gloved hand. The pin contacts in the receptacle are so enclosed by the shell that they cannot short in touching metal objects.

The receptacle is affixed to the battery case permanently. Its material is aluminum alloy, finished with black acid-proof lacquer. The two pin contacts are leaded copper with 12-24v. rating, 600 amp. continuous duty. The receptacle weighs approximately .513 lb.

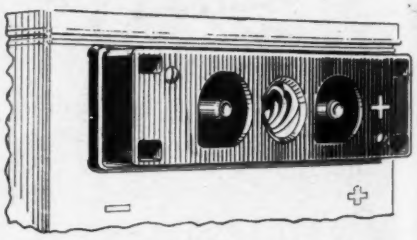
Plug shell material is molded phenolic, as is the 3½ in. dia. hand wheel. Early models had wheels made of aluminum alloy finished with acid-proof lacquer. The cap screw is die-cast zinc, and the plug weighs approximately 1.462 lb.

Cable outlets are on both ends of the shell, giving alternate arrangement of cables, if desired.

The complete connector will fit any G-1 standard battery conforming to AN-W-B-141 specifications.

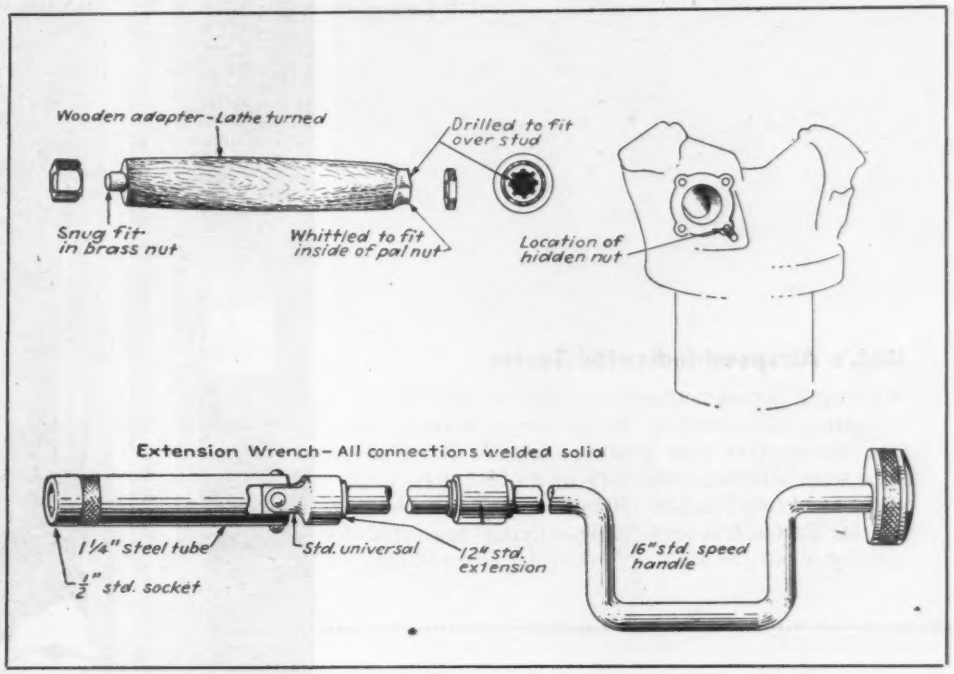


Drawing shows construction of battery plug. Large handwheel operates quick-thread extraction screw, and it can be turned by mechanic wearing even heaviest mittens.



Battery kit contains both protected terminals. This fitting remains on battery during entire service.

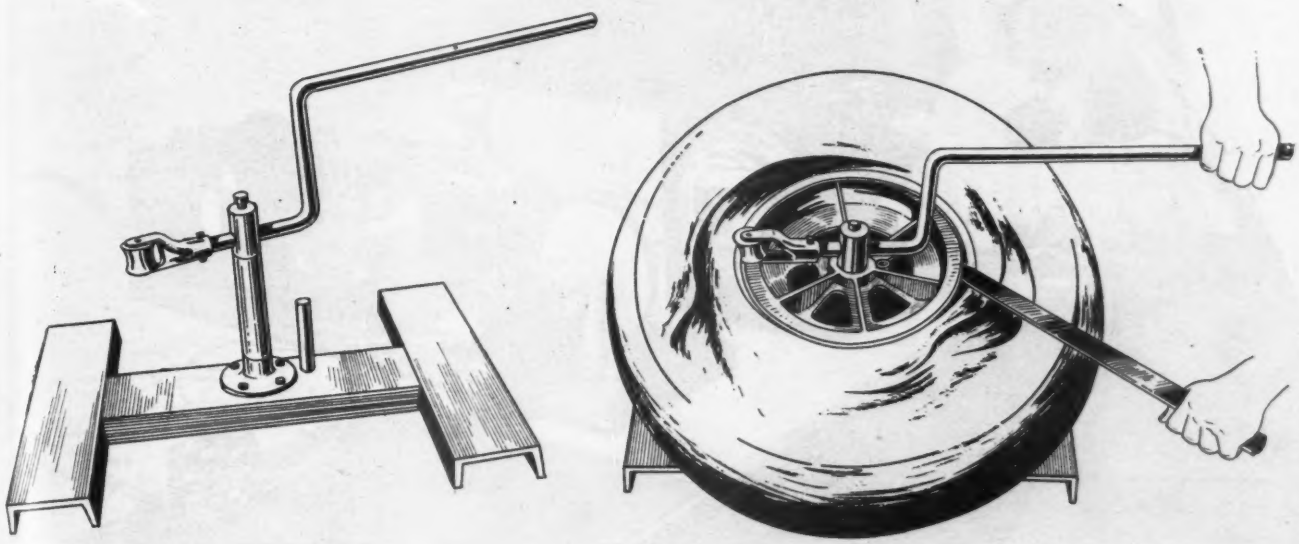
Exhaust Manifold Nut Wrench

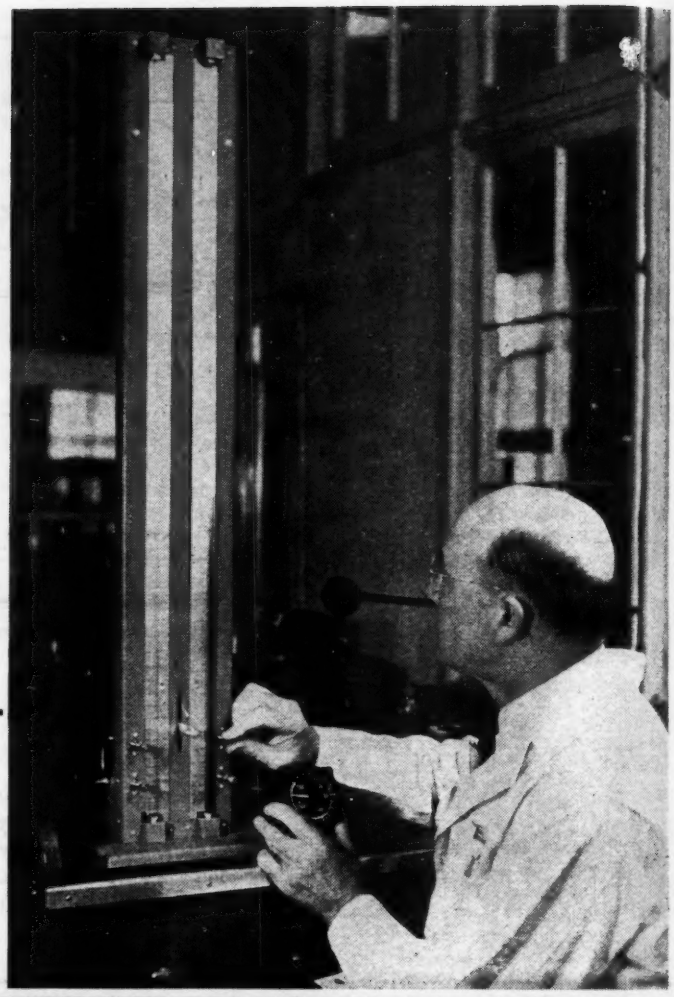

Wooden adapter - Lathe turned
Drilled to fit over stud
Snug fit in brass nut
Whittled to fit inside of pal nut
Location of hidden nut
Extension Wrench - All connections welded solid
1¼" steel tube
Std. universal
12" std. extension
16" std. speed handle
½" std. socket

• To start the inside corner nut on exhaust manifold flanges by hand is almost impossible, but by using this wooden adapter it becomes simple. One end fits the brass nut while the other is whittled down to fit inside the Palnut, the center being drilled out to fit over the stud. Jointed wrench (lower portion of illustration) is used to finish the job.

Cessna's Tire Mounting Tool

• With this tool, one man can mount a tire and tube in about a minute. Routine: (1) Remove handle from base spindle, (2) place wheel over spindle with anchor pin between spokes, (3) lay tire on wheel and replace handle, (4) hold lower bead over rim on one side with tire iron and roll bead over rim, (5) install tube in casing and roll over rim of wheel, placing valve stem through hole, and (6) roll top bead over rim. Tool can be used either on floor or low table. (Sketch re-drawn from an ASC bulletin.)



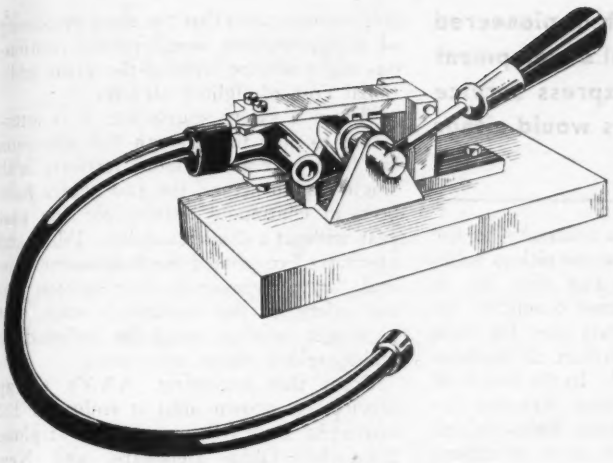


UAL's Airspeed-Indicator Tester

• Using a spring-actuated cylinder to develop air pressure corresponding to airspeeds marked in two manometers (see photo), United's Cheyenne base tests airspeed indicators up to 250 mph. (on right hand tube) and to 450 mph. (left hand tube). W. M. Bartosch is seen "hangar flying" an instrument at about 180 mph. (United Air Lines photo)

Eastern's Tach-Test Setup

• By means of a variable-speed drive (shown here at center of wood base) and a strobotac (left), Eastern Air Lines calibrates its electric tachometers throughout the full speed range of the instruments.



Rubber Tube Expander

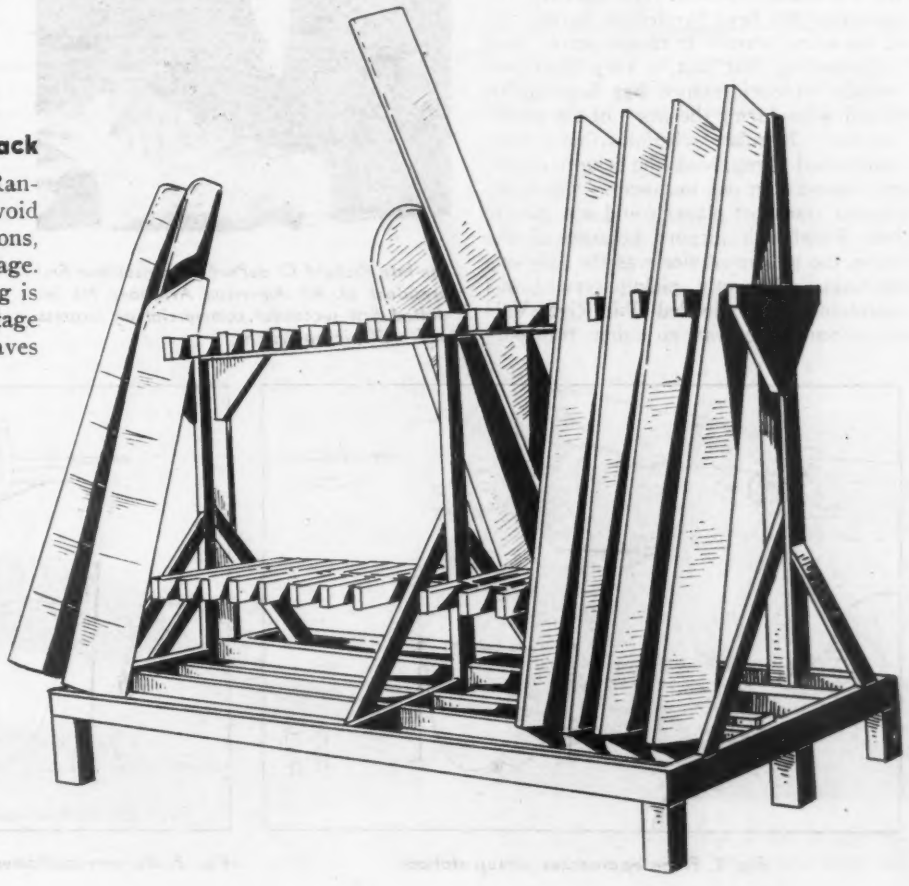
• Danger of splitting tubing when inserting fittings is eliminated at Curtiss-Wright's Buffalo plant by use of this two-jaw expander. Jaws are inserted into rubber tube, then handle is pressed, separating jaws. Fitting is slipped between jaws into tubing.

Northrop's Sheet Metal Clamp

• Devised by Clifford L. Nelson of Northrop, this simple but effective lifting clamp for moving sheet metal in the paint shop is constructed on the well known ice-tongs principle. It grips even the smoothest plates without scarring the surfaces.

Aileron and Flap Storage Rack

• Army's 89th sub-depot at Randolph Field built this rack to avoid risky handling of flaps and ailerons, with resulting chance of damage. Rack is so designed that padding is not required. Additional advantage over horizontal type is that it saves floor space.



AIRMAIL GOES RFD

By **EDWARD E. THORP,** *Assistant Editor, "Aviation"*

Here are the working details of the aero pickup system pioneered so successfully by All American Aviation—a practical development pointing the way to fast, reliable airmail and air express service for countless communities where conventional airports would either be uneconomical or impossible to install.

DESPITE THE FACT that proposed airpark and airport programs will bring the airplane's increasing utility to countless additional populated areas, there are still hundreds of communities in the United States where it is physically impossible to establish an airport.

These towns and cities can, however, be given adequate airmail and air express service through further development of a pickup service such as pioneered by All American Aviation.

Long since proved practical by this organization, with the system further tested by military operations, the aero pickup service seems destined for an even greater role in postwar transportation, both scheduled and non-scheduled.

After but one year's operation under leadership of the late Richard duPont, the Postmaster General reported that "the operation has been carried on during one of the worst winters in recent years. Notwithstanding that fact, a very high percentage of performance has been maintained, even during the worst of the winter months. Regular schedules have been maintained throughout the length of the two routes. In one instance in which the regular transport planes could not operate into Pittsburgh airport because of the snow, the pickup service was the only one operating. Recently, pickup service was maintained in the flooded Ohio River Valley when there was no other transportation and when it was necessary to use rowboats to place mail on the pickup poles.

"It is an established fact that, for an air route to be of greatest benefit to the public, planes must operate after the close of the business day to collect all business and late residential mail. In the month of Dec., 1939, All American Aviation installed a number of neon lights which proved the feasibility of night operations and demonstrated that the close proximity of pickup stations would permit continuous night service without the great additional cost of lighted airways.

"From a safety standpoint, it is interesting to note that though this operation has been over mountainous territory with single-engine planes, the two routes have been in continuous service for the past year without a single casualty. Pilots and operators," concluded the Postmaster General, "are unanimous in their opinion that the safety of this method is such that passenger service could be included, if multi-engined planes were used."

From this beginning, AAA's pickup service has grown until it embraces 112 towns in Pennsylvania, West Virginia, Kentucky, Ohio, Delaware, and New York. Proposals have been filed with CAB to extend the routes to cover 237 communities. So striking has the success of the system been that there are, at present, nine independent pickup airline companies projected, to cover 26 states and provide airmail service to 1,375 communities now dependent on surface delivery. Over 25,000 mi. will thus be added to present airline mileage, no small contribution to the total, especially when it is remembered that this work is done by single-engine planes.

Although it might be argued that any small plane can be fitted with a hook and be ready to go into the business, special equipment is required for successful operation.

First of all, a chute must be built into the bottom of the fuselage so that the container may be safely hauled into the plane. Then—as all fishermen who have bucked strong winds know—a hook on the end of a line needs some guiding, so a pole has to be fitted to carry the pickup hook and release it at the right time.

The late Richard C. duPont, organizer and first president of All American Aviation. He installed first successful commercial air express and mail pickup system.

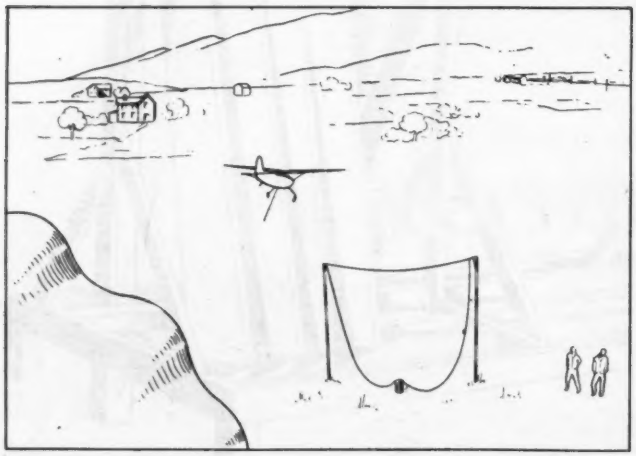


Fig. 1. Plane approaches pickup station.

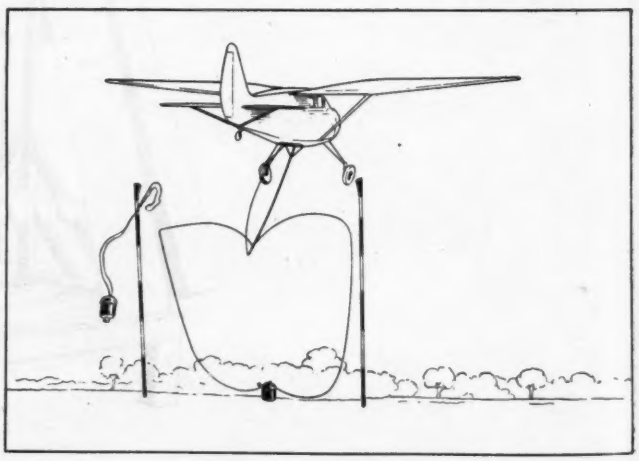


Fig. 2. Delivery container is released by pilot instant before pickup.

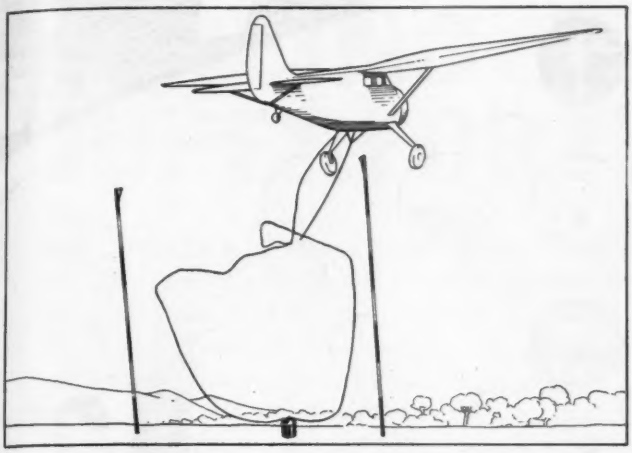


Fig 3. Pickup boom strikes transfer loop, which slides down to hook.

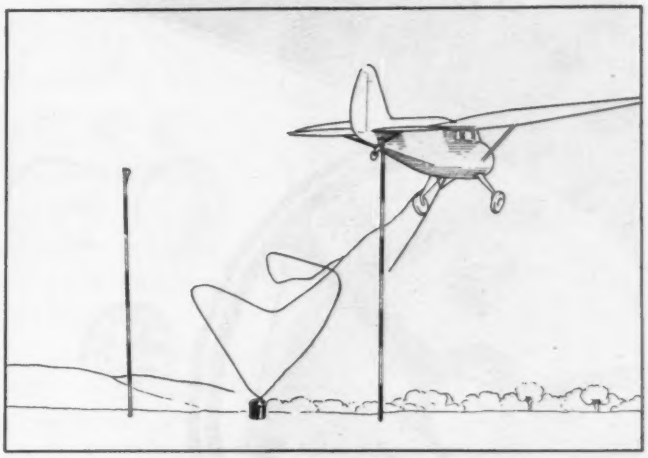


Fig. 4. Hook has been disengaged from boom. Rope is being wound up.

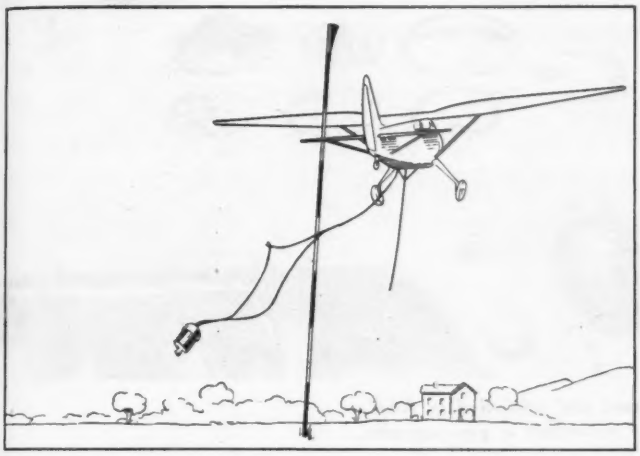
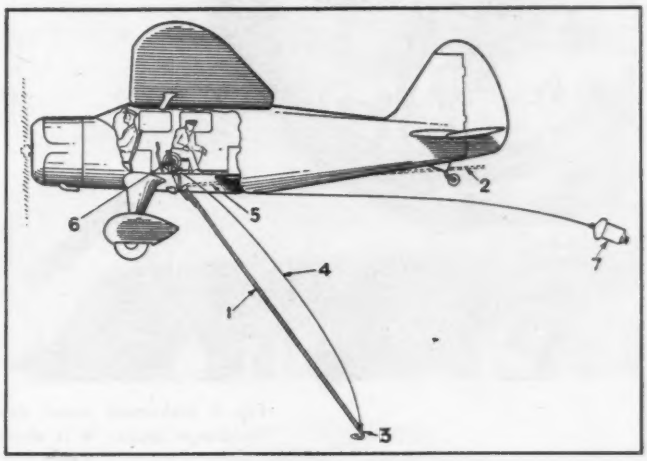


Fig 5. (above) Container about to be hauled inside plane. Fig. 6. (right) Section view of pickup plane. (1) is pickup boom, (2) indicates boom in retracted position, (3) pickup hook, (4) Nylon cord, (5) chute in bottom of fuselage for stowing packages, also recess for pickup pole, (6) accelerating and haul-up winch, (7) delivery container, which trails until released a moment before boom contacts loop.



After the pickup has been made, some device is required to cushion the first shock and in addition a mechanism is required to hoist the load into the fuselage before it can strike the ground and bounce up against the plane.

Partly by trial and error and partly through having a clear idea of requirements, the staff of AAA developed an apparatus so successful that it has been used by the Armed Forces to pick up gliders carrying the heaviest type of field equipment. The commercial package pickup operation is shown here in Figs. 1 to 5, while a section of the plane (Fig. 6) illustrates the working method.

The plane, a Stimson Reliant, carries a pilot and operator. It is fitted with a hickory boom (1), which has along its bottom surface a length of mast track (such as is used on sailing yachts instead of mast hoops for attaching sails to the mast). When not in use, the boom is carried in position (2) where it causes least drag. Hook (3), with its ⅛-in. Nylon cord (4), is placed in the track at the top of the boom and slides to the bottom in the position shown in Fig. 6. The loop of the ground package is placed on two poles, as shown in Fig. 1, the top

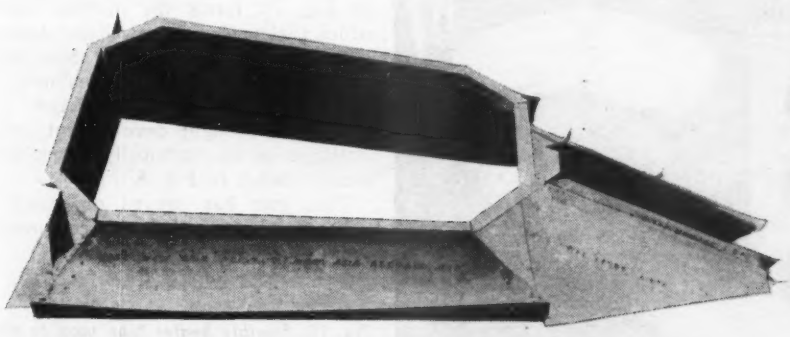


Fig. 7. Metal chute in bottom of fuselage, shown at (5) in Fig. 6.

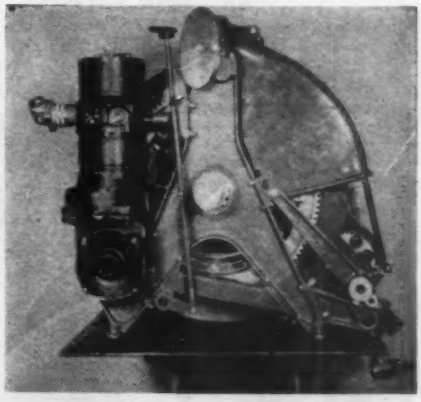


Fig. 8. Accelerating device and winch. Electric motor is at upper left, hook at lower right.

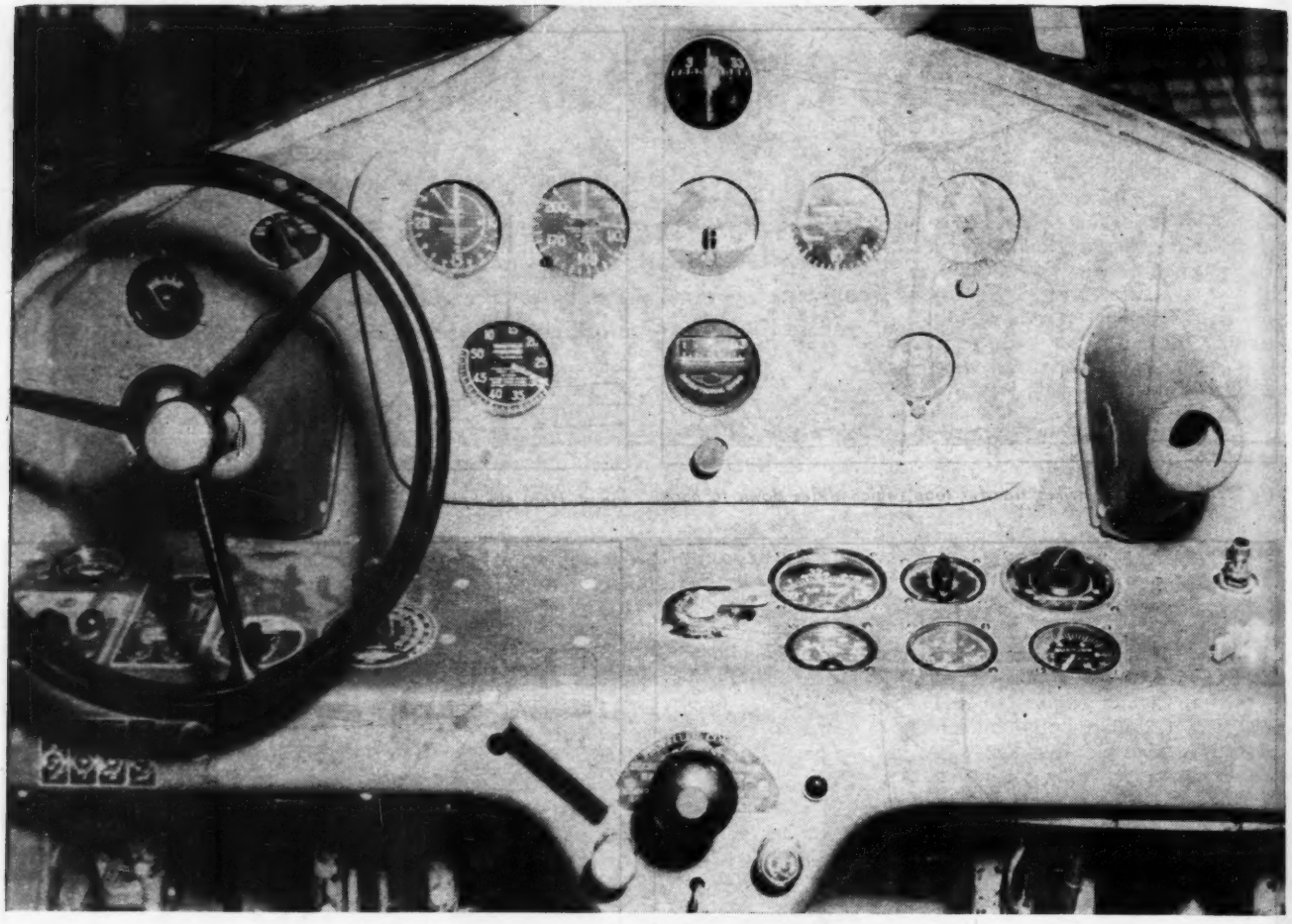


Fig. 9. Instrument panel, developed and fabricated in AAA's Pittsburgh shops. It is designed to include a gyro compass.

portion of the loop being in the path of the pole. When the boom strikes the loop (Fig. 2), the hook slips from the clip holding it in the track and pulls the loop from the top of the supporting ground poles (Fig. 3). After passing the pole position, the line is tightened by the plane (Fig. 4), until the container is in the air (Fig. 5).

Since the container often weighs up to 60 lb. and the pickup is made at 100 mph. only 30 ft. above the ground, the bottom of the fuselage is fitted with a stainless steel skin to prevent an accidental bounce from sending the entire container through the floor. For the same reason, a steel tubular protecting shoe is fitted beneath the rudder. The built-up chute (shown in Fig. 7) forms the opening through which packages are received and delivered.

Pickups are often made less than 5 min. apart. This speed, combined with the increasingly heavy packages being lifted, has brought development and installation of an electrically driven power winch, shown in Fig. 8.

This unit has proved of exceptional military value—for it is this equipment, in

(*Turn to page* 177)

Fig. 10. Flexible heater tube used to defrost windshield and heat rear cabin.

The B.F. Goodrich Airplane of the month

BOEING B-29 SUPERFORTRESS

SUPERLATIVES have always been used, and often too freely, in describing new warplanes. For the B-29, however, superlatives seem strangely inadequate. No one warplane has ever made such a startling debut or suggested such awe-inspiring potentialities as the Boeing Superfortress.

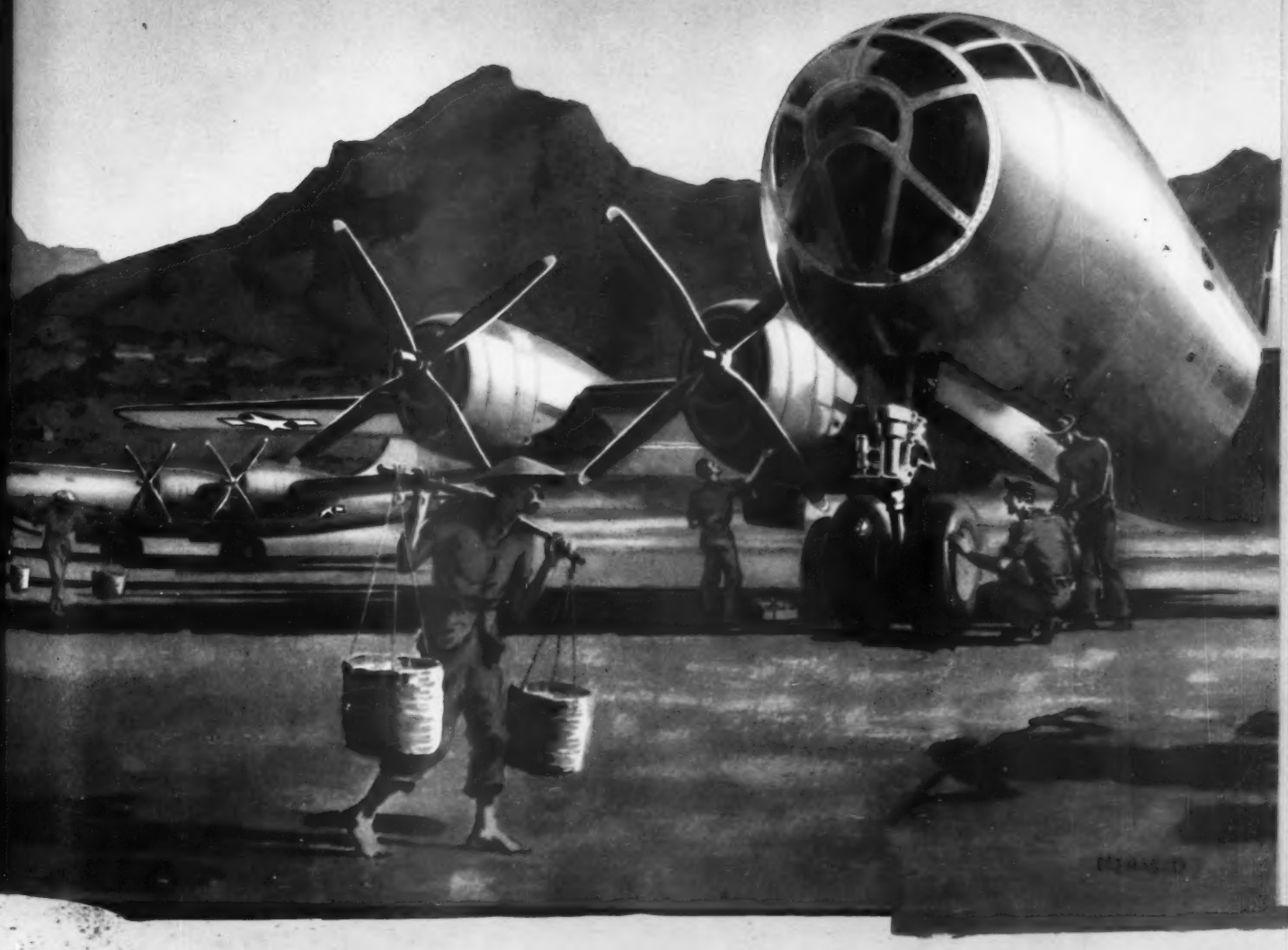
Little can be added here to the glowing tributes that have already appeared hundreds of times in the public press. Suffice it to say, this airplane is destined to write its own eulogy on the pages of history.

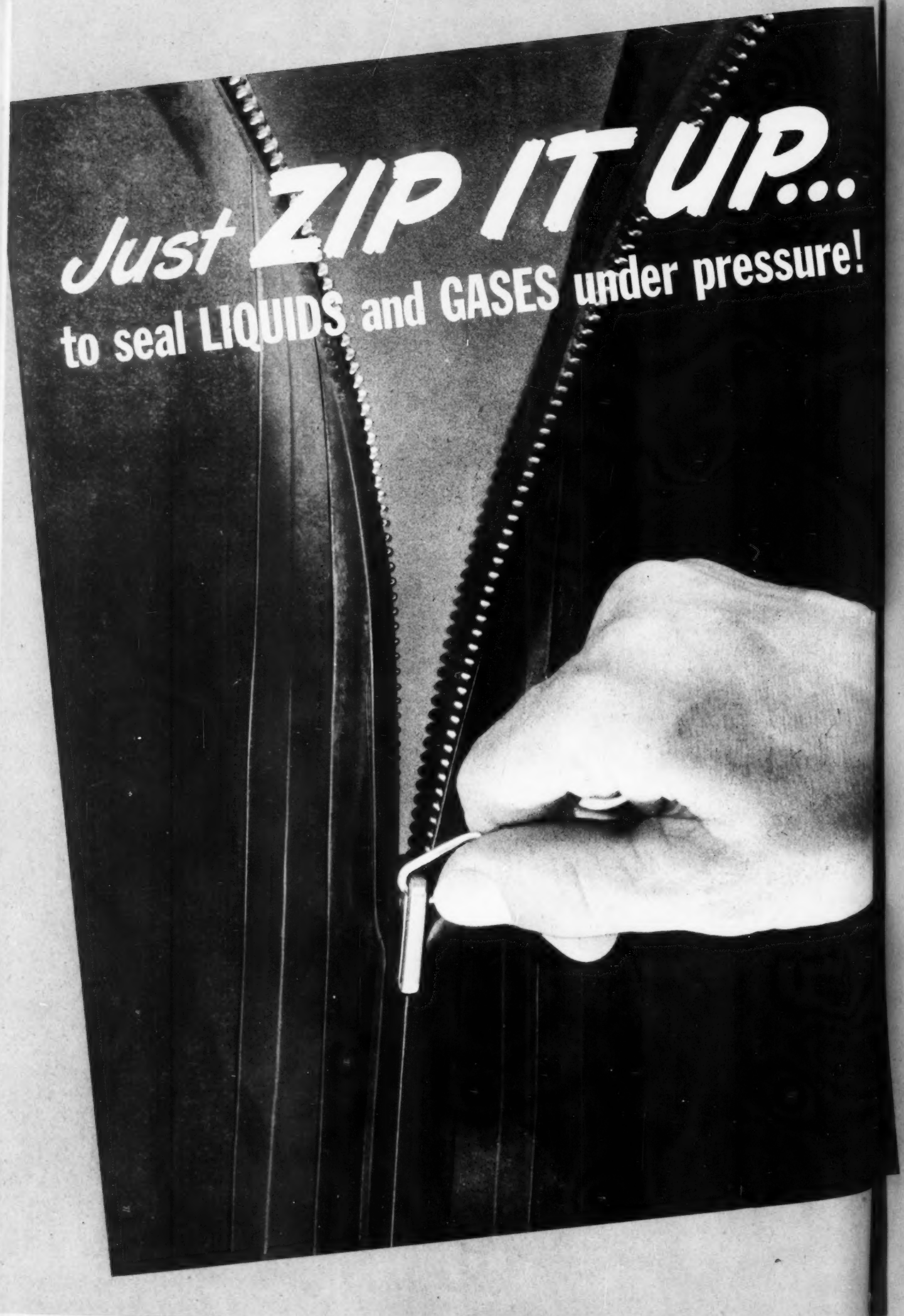
Every man and woman who helped make the B-29 possible shares abundant credit for a remarkable achievement. Adding one more handclap to a nation's applause, B. F. Goodrich salutes Boeing—names the Boeing B-29 Superfortress "Airplane of the Month."

In war or peace

B.F. Goodrich

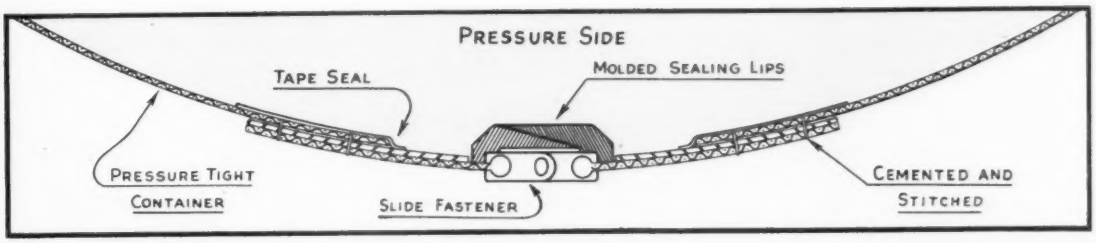
FIRST IN RUBBER




Just ZIP IT UP...
to seal LIQUIDS and GASES under pressure!

Introducing the B.F. Goodrich PRESSURE SEALING ZIPPER

Perhaps YOU can use it



ONE of the newest products of B.F. Goodrich research is a zipper which won't let gases or liquids through, even under high pressure.

B. F. Goodrich engineers have taken a slide fastener and added a precision-molded rubber seal that opens and closes with the fastener. This seal is a unique arrangement of overlapping rubber lips which provides an effective and complete seal from zero pressures to pressures up to the structural strength of the fastener itself.

B. F. Goodrich Pressure Sealing Zippers can be applied to metal, fabric, or sheet rubber, provided a sufficient clearance is allowed for proper operation of the fastener. They may be installed by stitching or cementing, depending on application.

These zippers are effective in a wide temperature range. The rubber won't crack when bent at −70° F. nor become soft at 150° F. Weatherability is good; aging tests have shown present compound is best possible for this type of product.

Three types of B. F. Goodrich Pressure Sealing Zippers to choose from

Style 400: Non-Separating type seals throughout its entire length but is open at the top. It has a slider which can be operated from either or both sides. This type of closure may be used in applications such as exposure suits.

Style 410: Separating type; seals for entire length but not at ends. Slider operates from either or both sides. This type is now being used effectively as an aileron gap seal.

Style 420: Non-Separating type. Seals at both ends and along entire length. Slider operates from side opposite sealing lips. Originally developed as a closure for pressure vessels, it suggests many other interesting uses.

Aeronautical uses

Among the many uses suggested for this unusual closure are the following aeronautical applications: (a) For joining sections of both low- and high-pressure ducts. (b) Sealing doorways and hand-holes where there are pressure differentials. (c) Sealing bail-out kits and instrument cases. (d) Weather seals. Undoubtedly many more uses will come to our attention as people learn about the B. F. Goodrich Pressure Sealing Zipper.

Perhaps you may think of a use for it. Our engineers will be glad to call on you and discuss your applications. The B. F. Goodrich Co., Aeronautical Division, Akron, O.

ARMY NAVY

Awards to 9 plants

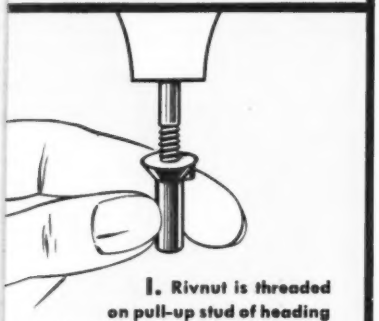
Skyway or Highway

B.F. Goodrich

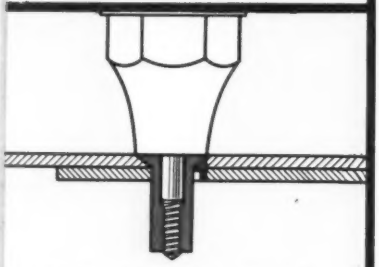
FIRST IN RUBBER

NEW RIVNUTS FOR WIDER RANGE OF FASTENING APPLICATIONS!

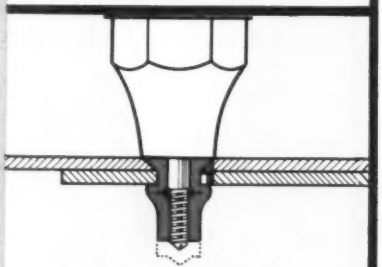
RIVNUT installation is SIMPLE... FAST... FOOL-PROOF!



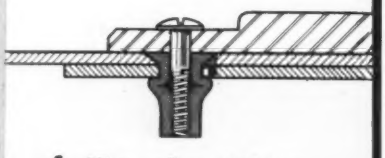
1. Rivnut is threaded on pull-up stud of heading tool until it touches the anvil.



2. Rivnut and pull-up stud is placed in hole with Rivnut head firmly against, and at right angles to, the work.



3. A squeeze on the tool lever retracts pull-up stud slightly, causing a lateral bulge upset of the Rivnut.



4. When pull-up stud is removed, the Rivnut can be used as a nut plate. Threads grip accessory screw firmly.

TWO NEW KINDS of B.F.Goodrich Rivnuts—Brass and Splined Aluminum—have recently been added to the line. Both of these new types, like the regular aluminum Rivnut, can be used as a blind rivet, as a nut plate for attachment, or as both at once. In addition, the new types have the same advantages as the standard Rivnut. They're simple in design (one-piece); they're compact—require a smaller hole yet have larger bearing area than any other blind fastener; they're ready for use as received. More complete information about each type is given below:

SPLINED ALUMINUM

This Rivnut is ideal for use as a nut plate in wood or plastics because the splined shank gives excellent torsion resistance. A full range of sizes and head types is available.

BRASS This is one of the newcomers—a stronger B. F. Goodrich Rivnut for blind fastening where greater tensile and shear strength is required (about 50% stronger than aluminum). Production now limited to sizes 6, 8, and 10. More sizes will be announced when available.

53-S ALUMINUM ALLOY

This is the standard Rivnut originally designed for aeronautical use and now doing hundreds of fastening jobs. It is light, strong, corrosion-resistant . . . and so easy to install, even a blind man can do it. Full range of types, sizes, grips available.

For more facts, get "RIVNUT DATA"

Contains full information on Rivnut types, sizes, grip ranges, etc.—also step-by-step illustrated installation procedure. For your copy, write to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

B.F.Goodrich

RIVNUT

IT'S A RIVET...IT'S A NUT PLATE

heavier adaptations, that has performed wonders at the battle fronts, picking up loaded gliders from places too small for operation by power planes.

A drum carries approximately 150 ft. of ⅜-in. Nylon cord which has a breaking strength of over 750 lb. Normally the drum is free to turn, allowing the line to start unwinding at the first tension after pickup. As soon as the drum begins to revolve, it tightens a disk brake until, when about half the line has run out, the drum has almost ceased to turn and the load is traveling at the same speed as the plane.

As soon as the drum stops, an automatic switch starts the electric motor which hauls in the cord and package. Through this automatic action, the operator is free to prepare for the next pickup. Frequently it is necessary to circle and pick up several times at one place, when mail and express shipments are very heavy.

Several changes in design of the plane itself were found desirable, not because of any deficiency in the original engineering, but because of the unusual service to which the planes have been put.

Normally the plane has had the fuse box in the floor, where it was easily accessible. But with containers bringing in snow, mud, or rain, it was found advisable to put the box in the side wall.

Fig. 9 shows the new instrument panel designed to include a directional gyro—extremely necessary where all flying is "contact" and fog hangs in the valleys for days at a time. This panel, made in the AAA shops at Pittsburgh, is a typical example of the type of work done by the maintenance force.

In a comparatively small fuselage, with a large opening in the floor through which a hurricane-like wind can travel at will, the heating problem was acute; so an additional flexible hot air tube (Fig. 10) was fitted, both to defrost the windshield and to heat the rear of the cabin where the operator worked. The end of the tube was covered with asbestos to permit it to be handled when conditions called for changing the position of the warm air.

As a precautionary measure, AAA is fully equipped to deal with and repair any accident damage which does not totally wreck a plane. A completely fitted truck, so arranged that its rear forms a nose hangar, is ready at all times to leave for any part of the territory covered by the system. To permit the emergency crew to communicate with the Pittsburgh base, a portable radio set (Fig. 11) is carried. It contains battery and reel antenna in addition to the radio equipment. By this means, the crew of the truck may notify the home base of needed parts, pieces or units, which are then flown by another plane fitted with drop equipment and parachutes for delivering heavy or delicate parts.

From two routes serving 78 daily pickups, AAA has grown to operate five averaging 275 mi. each, serving communities with populations of from 600 to 120,000 twice daily. Forty-four of these places can never have airports, some because their size would render them uneconomical, some because there is no level space in which to locate fields.

The entire United States contains 10,346 such communities having less than 1,000 people, almost all of which can be immeasurably benefited by airmail pickup. As new routes and lines are formed, the operating companies will comprise a not inconsiderable group of continuous customers for medium-size aircraft and the supplies required to service them.

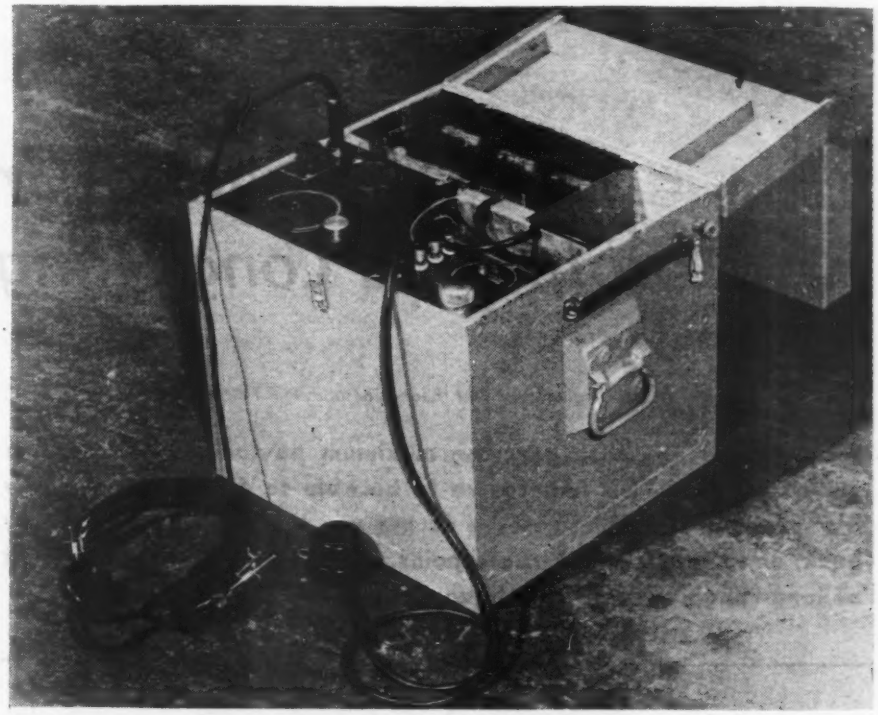


Fig. 11. Portable radio set contains battery (back left), reel antenna (back right), and short wave set (front). Cover is hinged so battery may be kept enclosed while using radio. This equipment was also designed and built at AAA's Pittsburgh shops.

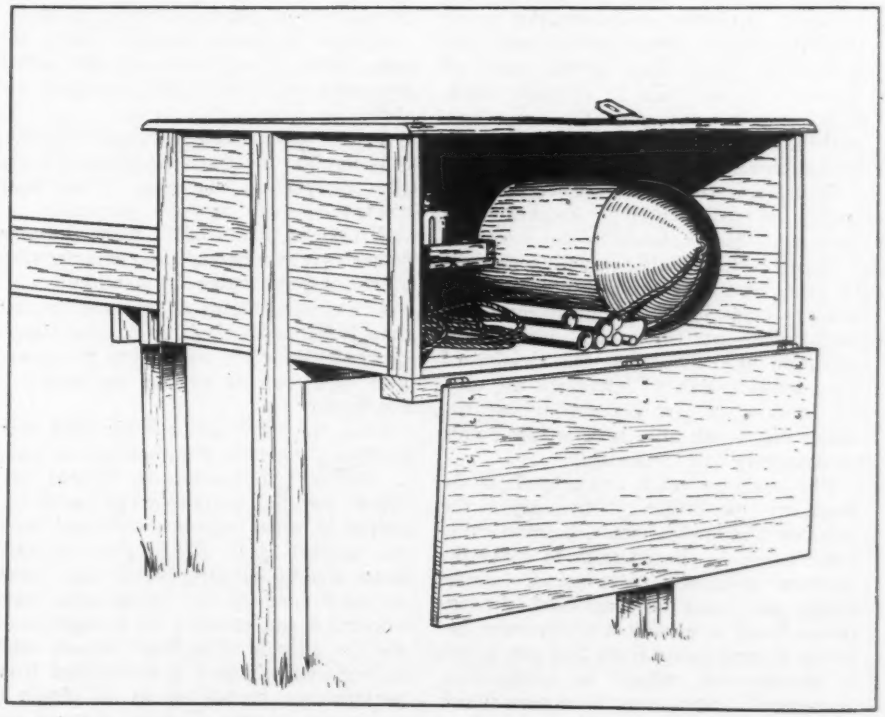


Fig. 12. The "pocket airfield." Equipment includes jointed poles, Nylon lines, flares, and a container made from heavy rubber and having a bumper on "business end".

How Calculated Cruising Foolproofs Long-Range Flights

By **JAMES B. REA**, *Engineering Test Pilot, Consolidated Vultee Aircraft Corp.*

When you're en route carrying maximum payload on a minimum quantity of fuel, it's imperative to be able to determine in a jiffy if you've sufficient fuel reserve to get you there, or to turn and fly back, or to reach an alternate point. Here's a pertinent treatment of long-range cruising technique for trans-ocean flight.

TO A FERRY PILOT delivering a plane to a distant war zone, a long-range cruising technique may well be important—but such a technique is even more important to a pilot who flies the same distance for a commercial airline. The ferry pilot usually fills his gas tank before takeoff, whereas the commercial pilot must carry a maximum payload and, consequently, a safe minimum amount of fuel.

Thus, it is essential that every commercial pilot engaged in long-range flying acquire reliable technique for determining, in flight, instantaneous information as to the fuel reserve remaining to reach the destination, to fly back to the point of departure, or to attain an alternate point, basing the calculation on the latest avigational progress and fuel consumption indications at that time.

Before this technique is discussed, the general procedure used in preparing for long-range flights should be understood.

Expert meteorologists, usually employed by the operating company, construct weather maps based on fundamental meteorological data collected at various observation stations within the vicinity of the intended route. These maps are used to forecast the weather throughout the entire flight-path area between the points of departure and destination.

The optimum track and altitude to be flown are then decided. Obviously, if the weather were not a factor, a great-circle track would be chosen so as to cover the shortest distance. But since winds, fronts, etc., must be considered, the optimum track is usually a compromise between a great-circle track and one which is chosen with regard to winds only. Sometimes a track must be chosen which will avoid hazardous weather regardless of increase in flight time and consequent loss in payload.

Here are some of the factors to be considered in choosing an optimum altitude:

1. Wind velocity varies with altitude, both in magnitude and direction, and the optimum altitude chosen, or combination of altitudes chosen, should take this into account.

2. The altitude should be chosen with regard to clearance of cloud tops. A flight made "over the top" is considerably smoother, and much easier on passengers and crew. It allows the plane to settle down to relatively stable conditions with a slight increase in airspeed. Avigation is made steadier, stars are more likely to be visible, and star sights are more accurate in the smoother air above the clouds.

3. In choosing an optimum altitude, consideration must also be given to overall powerplant efficiency. The most efficient altitude for any particular installation usually depends upon the type of carburetor used and the characteristics of the supercharging installation.

4. Extended flights at altitudes greater than 10,000 ft. in airplanes without supercharged cabins are enervating to passengers and crew if oxygen equipment is not used.

Once the track and altitude have been decided, a complete flight analysis is made as follows: The track is divided into zones, and the average wind to be expected in each zone is determined from the weather map. Knowing the average gross weight for the plane in each zone, as determined by fuel consumption consideration, and knowing the average wind, also the altitude to be flown in each zone, an optimum airspeed is determined from performance curves so as to obtain a maximum number of miles covered per pound of fuel burned.

It may be found that when total costs are considered, a speed higher than maximum range speed is most economical. With this optimum airspeed and average wind, the ground speed and time through each zone is computed. Total flight time is simply the sum of the zone flight times.

The basic amount of fuel to be taken is primarily a function of the total forecast flight time. In addition to this basic amount, a reserve must be carried. With four-engine equipment operating long-range over water, this reserve should be based on: (1) The possible necessity of three-engine operation, (2) the time on four engines required to reach the three-engine equi-time point, and (3) the general knowledge of forecasting acquired by the operating company through past experience in long-range flying.

The equi-time point is that from which it would take just as long to continue to the point of destination as it would take to return to the point of departure.

Distance to ETP$_3$

The time on four engines required to reach the three-engine equi-time point is determined by first calculating the distance to the three-engine equi-time point, then dividing this distance by the average ground speed out on four engines. The distance to the three-engine equi-time point, ETP$_3$ may be determined by the formula:

$$d_f = \frac{D \times S_{rsf}}{S_{rsf} + S_{esf}}$$

where d_f is the distance to the ETP$_3$ as of forecast, D the total track miles to the destination, S_{rsf} the average ground speed to return on three engines as of forecast, and S_{esf} the average ground speed to continue on three engines as of forecast.

It seems obvious that the most important questions to be answered in long-range cruising technique are:

1. How much fuel has been used?

2. Are we ahead or behind our forecast schedule?

3. Do we still have the proper fuel reserve to continue to our destination with safety?

The answer to the last question is the most important, and it is dependent on knowing the answers to the other two.

Avigation alone is responsible for the answer to the second question, while fuel gage readings indicate the answer to the first.

Information determined by the avigator as to whether the flight is ahead or behind schedule means nothing in determining if there is a proper reserve to continue to the destination—unless it is known how much fuel has been used. For example, an airplane may be ahead of scheduled forecast time only because of high airspeeds resulting from excessive power and over-consumption of fuel.

One of the simplest methods for determining, in flight, the continuous up-to-the minute answers to these questions, is to compare the actual fuel consumption with forecast normal fuel consumption and, at the same time, to compare the actual avigational progress with the forecast avigational progress. A graphic means for indicating the answers is shown by the following example of long-range trans-ocean "Howgozit" technique:

First, the total amount of fuel to be taken on a flight is determined. If the optimum altitude as computed from the flight analysis is 10,000 ft., and if the total forecast flight time at this altitude is 16 hr., then the basic amount of fuel could be 18,260 lb., as determined from long-range performance curves of fuel consumption vs. flight time for various altitudes and head wind components.

The reserve to be carried, in addition to the basic amount, may be obtained from a typical curve as shown in Fig. 1. If, based on the flight analysis, the time on four engines required to reach the three-engine equi-time point is 9 hr., then the reserve from the origin to ETP_3 will be 1,490 lb., and the reserve from ETP_3 to the destination will be 1,995 lb. An additional reserve of 1,200 lb. is required for the possible necessity of flying another hour on three engines after arrival. Thus, the total reserve would be 4,685 lb., and the total amount of fuel to be taken is 22,945 lb. The foregoing figures are merely examples and do not necessarily represent fuel consumption values for any particular plane.

Immediately after takeoff, a curve of normal fuel consumption is plotted vs. Greenwich Civil Time, as shown in Fig. 2. The data used for drawing this curve are obtained from fuel consumption and performance information based on flight test data.

For example if the takeoff (see Fig. 2) is at 0030 G. C. T., and if the performance curves for long-range cruising at 10,000 ft. indicate that it will take 45 min. to climb to that altitude, and that 1,600 lb. of fuel will be consumed during the climb, then a point is located at 1,600 lb. under a G. C. T. of 0115 to indicate the end of the climb. For 8 hr. of flight time, the performance curve indicates 9,900 lb. consumed and the G. C. T. would be 0830, etc.

Next, a curve of reserve vs. G. C. T. is drawn from the point at the end of the climb through the point of 1,490 lb. of reserve at the ETP_3 (0930 G. C. T.), and through the point of 3,485 lb. reserve at the end of the 16 hr. flight (1630 G. C. T.). This latter reserve does not include the 1,200 lb. carried for the possible necessity of flying another hour on three engines after arrival.

A table is then made for fuel consumption and avigational score at various G. C. T.'s. On every hour during the flight, the engineer enters the amount of fuel consumed as determined from his gages, and the avigator enters the avigational score—plus, if ahead of forecast, and minus if behind. From the data in this table, a progress line is plotted.

For example, at 0700 G. C. T. the fuel consumed is 8,500 lb. (an over-consumption of 420 lb.) and the flight is 12 min. behind forecast. Thus, the progress line runs through point *A* which is placed 12 min. to the left of the actual fuel consumption point of 8,500 lb. at 0700 G. C. T. A curve of actual consumption vs. G. C. T. may also be drawn (but is not shown) in Fig. 1.

By noting the relation between the progress line and the reserve line, it can easily be determined whether it is advisable to continue or return to the point of departure. If at the ETP_3, the slope of the progress line is such that it looks as though it will intersect the reserve line before completion of the flight, it is advisable to return.

The three-engine equi-time point is critical on long-range flight, not only from the standpoint of fuel reserve but also from the standpoint of possible engine failure. If an engine should stop before this point is reached it would take less time to return on three engines than it would to continue the flight.

Also, if failure of one engine happened to occur at, or near, the ETP_3, it would still be advisable to return because the winds to be encountered on the way back would probably be the same as those encountered on the way out and would be more dependable than the forecast winds ahead. But if an engine should fail after the ETP_3 had been well passed, it would obviously be logical to continue to the destination.

Shifting Equi-Time Point

It is current practice to shift the forecast ETP_3 by an amount equal to the time ahead or behind forecast. For example, if when approaching the forecast ETP_3 it is found that the flight is ahead of forecast, the time to the new or up-to-the-minute ETP_3 is found by decreasing the time to the forecast ETP_3 by the amount that the flight is ahead of forecast. Similarly, if the flight is behind forecast, the time to the new ETP_3 is increased by that amount.

It seems obvious that the time to the ETP_3 should be increased when behind forecast and decreased when ahead of forecast, but it is not obvious that this change should be just equal to the time ahead or behind forecast. The following is a mathematical proof justifying the practice of shifting the forecast ETP_3 by an amount equal to the time ahead or behind forecast:

Symbols—

D = Total track miles to destination.
S_{r3f} = Average ground speed of return on three engines, as of forecast.
S_{c3f} = Average ground speed to continue on three engines, as of forecast.
S_{o4f} = Average ground speed out on four engines, as of forecast.
S_{r3n} = Average ground speed of return on three engines, as of new.
S_{c3n} = Average ground speed to continue on three engines, as of new.
S_{o4n} = Average ground speed out on four engines, as of new.
d_f = Distance to ETP_3, as of forecast.
d_n = Distance to ETP_3, as of new.
t_f = Time to ETP_3 as of forecast.
t_n = Time to ETP_3 as of new.
t_{af} = Actual time to arrive at forecast ETP_3.

Time ahead $= t_f - t_{af}$ = time ahead of forecast.

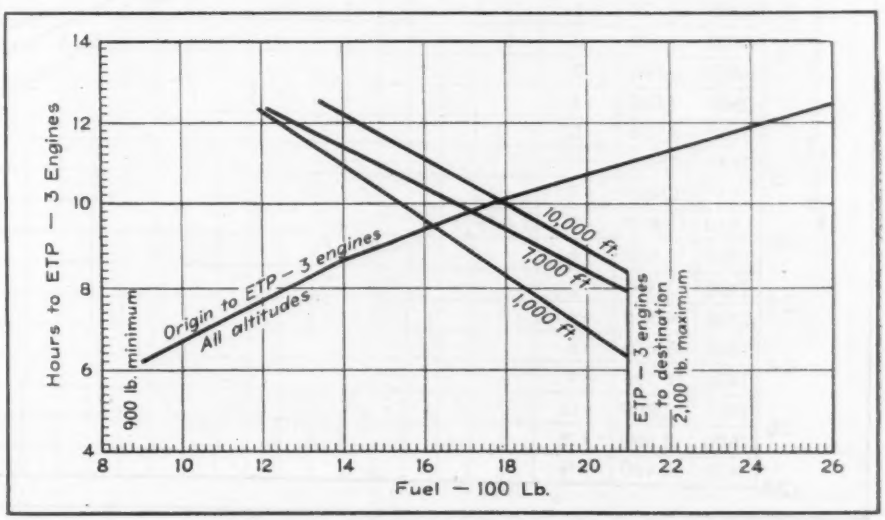


Fig. 1. Graph of fuel reserve required from origin to three-engine equi-time point, and from latter to destination.

ETP = Equi-time point.

To prove:

$t_f - t_n$ = Time ahead of forecast.
$t_n - t_f$ = Time behind forecast.

Proof:

$$d_f = \frac{D \times S_{r3f}}{S_{r3f} + S_{c3f}} \quad (1)^*$$

$$\text{Also, } d_n = \frac{D + S_{r3n}}{S_{r3n} + S_{o3n}} \quad (2)^*$$

$$\text{and, } t_f = \frac{d_f}{S_{o4f}} = \frac{D \times S_{r3f}}{S_{o4f}\,(S_{r3f} + S_{c3f})} \quad (3)$$

$$\text{also, } t_n = \frac{d_f}{S_{o4n}} = \frac{D \times S_{r3n}}{S_{o4n}\,(S_{r3n} + S_{c3n})} \quad (4)$$

Combining equations (3) and (4), and rearranging,

$$t_n = t_f \left(\frac{S_{o4f}}{S_{o4n}}\right)\left(\frac{1 + \frac{S_{c3f}}{S_{r3f}}}{1 + \frac{S_{c3n}}{S_{r3n}}}\right) \quad (5)$$

But, for lack of better information, it is current practice to consider $S_{c3n} = S_{c3f}$. In other words the new three-engine speed to continue should be considered the same as the forecast three-engine speed to continue, in absence of additional forecast data.

Thus,

$$t_n = t_f \left(\frac{S_{o4f}}{S_{o4n}}\right)\left(\frac{1 + \frac{S_{c3f}}{S_{r3f}}}{1 + \frac{S_{c3f}}{S_{r3n}}}\right) \quad (6)$$

To a very close approximation, the factor

$$\left(\frac{1 + \frac{S_{c3f}}{S_{r3f}}}{1 + \frac{S_{c3f}}{S_{r3n}}}\right) = 1$$

And so,

$$t_n = t_f \left(\frac{S_{o4f}}{S_{o4n}}\right), \text{ approx.} \quad (7)$$

Actual experience has shown that the accuracy of equation (7) is well within the limits of avigational error, thus justifying the use of this simplified form as compared with equations (5) and (6).

$$\text{Also, } S_{o4n} = \frac{d_f}{t_{af}} \quad (8)$$

Thus, from eq. (8), $\frac{S_{o4f}}{S_{o4n}} = \frac{S_{o4f} \times t_{af}}{d_f}$

$$\text{But, } t_f = \frac{d_f}{S_{o4f}}$$

$$\text{So, } \frac{S_{o4f}}{S_{o4n}} = \frac{t_{af}}{t_f} \quad (9)$$

Combining equations (7) and (9), we have,

$$t_n = t_f \times \frac{t_{af}}{t_f}$$

$$\text{or, } t_n = t_{af} \quad (10)$$

But,

$t_{af} = t_f -$ (time ahead of forecast).
$= t_f +$ (time behind forecast).

Thus,

$t_f - t_n$ = time ahead of forecast.
$t_n - t_f$ = time behind forecast.

Thus, it has been proved that the new ETP_3 may be determined by shifting the forecast ETP_3 by an amount equal to the time ahead or behind forecast. It should be shifted ahead if behind forecast, and behind if ahead of forecast.

Though a plane may be inherently efficient, it is of little value to a commercial company operating long-range flights unless a reliable and economical cruising technique is thoroughly understood by the operating personnel.

* To justify use of equation, see any standard derivation for distance to ETP.

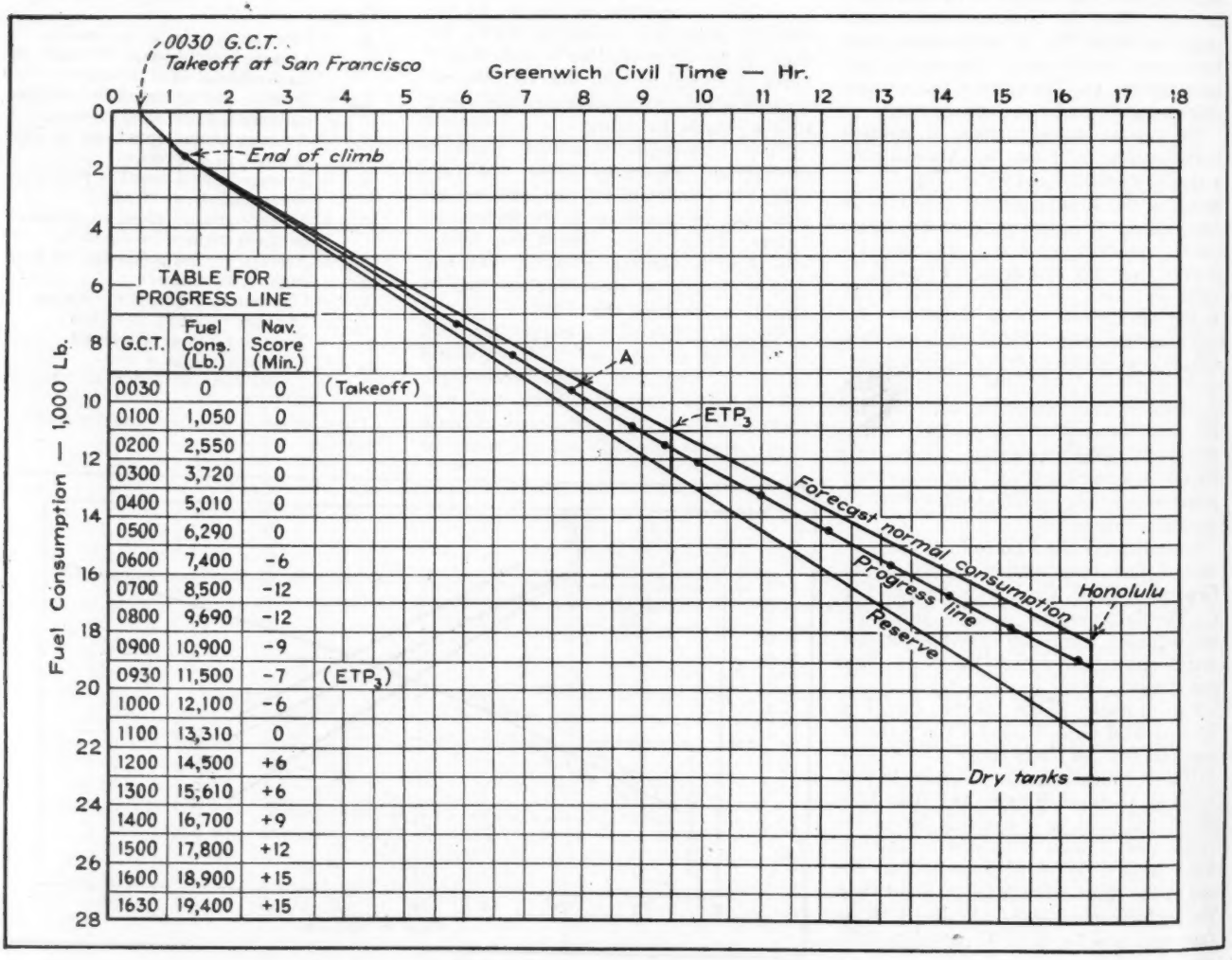

0030 G.C.T.
Takeoff at San Francisco
Greenwich Civil Time — Hr.
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
End of climb
A
ETP3
Forecast normal consumption
Progress line
Reserve
Honolulu
Dry tanks
Fuel Consumption — 1,000 Lb.
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28

TABLE FOR PROGRESS LINE

G.C.T.	Fuel Cons. (Lb.)	Nav. Score (Min.)	
0030	0	0	(Takeoff)
0100	1,050	0	
0200	2,550	0	
0300	3,720	0	
0400	5,010	0	
0500	6,290	0	
0600	7,400	-6	
0700	8,500	-12	
0800	9,690	-12	
0900	10,900	-9	
0930	11,500	-7	(ETP_3)
1000	12,100	-6	
1100	13,310	0	
1200	14,500	+6	
1300	15,610	+6	
1400	16,700	+9	
1500	17,800	+12	
1600	18,900	+15	
1630	19,400	+15	

Fig. 2. "Howgozit" graph of normal fuel consumption plotted against Greenwich Civil Time, for San Francisco-Honolulu flight at 10,000 ft.

Airspeed-Dial Device Simplifies Range Procedure

By CHARLES A. MOBLEY,
Aerodynamic Research Engineer, Lockheed Aircraft Corp.

For the military pilot, attainment of maximum range is a prime "must." This dial card was designed to tell him how—in less than 30 words.

BRIEF AND EXPLICIT data to assure maximum-range operation is of major importance to our military pilots flying against the Axis. Accordingly, extensive study has been made of ways to present information to aid in achievement of such performance, but while there has been steady improvement in attacking the problem, methods have remained rather conventional.

Now, however, a special procedure for obtaining maximum range has been conceived—a procedure employing a durable card device, with a hole in the center for attachment over the pilot's airspeed indicator dial. This location was selected since the most important factor affecting maximum range is airspeed.

The optimum airspeed for best range is indicated by a bright red arrow, the location of which is corrected for position error and parallax. In addition, the ship's indicated airspeed is printed in bold type on the arrow in case some installations may not agree properly with the airspeed instrument scale. The card is printed in red and white on a black background, and the surface is varnish-coated on both sides for protection from moisture.

To arrive at the rules, the factors affecting maximum range were studied, and this information, based on tenets in the *Pilot's Handbook*, was condensed to less than 30 words which constitute the five rules for maximum range operation.

Rule 1 (see condensed procedure data on card in illustration) insures operation near maximum L/D for the usual operational gross weights. Rule 2: Makes r.p.m. the major variable. Rule 3: Insures operation near maximum bmep for efficient engine operation. Rule 4: Stipulates mixture and blower settings for maximum range. And Rule 5: Prevents operation at too low an engine speed, which would cause mixture enrichment and possible difficulty with the generator cutting out.

Located directly in front of the pilot, the card serves to remind him of correct operating procedure whenever economy is desired. Many mistakes are thus avoided, and the effective service range of the aircraft is materially improved.

This increase in service range may in some cases amount to 10 percent. Considered from another angle, the payload may be increased by 10 percent of the gross fuel weight. For a plane with 1000-gal. normal fuel supply, a 600-lb. increase in bomb load may be realized. Evaluating this additional bomb load on the basis of $200 per pound increase in payload, as would be the minimum in the case of a commercial airplane, the increased value, over the life of the aircraft, would amount to $120,000. The true military value may be even higher.

Analysis shows that the five simple rules will result in ranges within 3 percent of maximum possible obtained by varying speed with gross weight and suiting engine and propeller settings to flight conditions. Over the range of gross weights normally used in patrol activities, the difference is even less, amounting to about 1½ percent.

Procedure card for obtaining maximum range is attached over airspeed indicator. Photograph shows dummy airspeed indicator dial with card in position over it. Arrow indicates best speed for maximum range and number on arrow is plane's indicated airspeed, assuring agreement between installation and airspeed instrument scale.

Mexico Offers Flyers Thin Air . . . And Opportunities

Two of major peaks which landmark rugged terrain for flyers in Central Mexico are the volcanoes Ixtachihuatl (above, left) and renowned Popocatepetl (right), rising 16,883 ft. and 17,887 ft., respectively.

These "three-milers" are 50 mi. southeast of Mexico City. Photo below shows Balbuena Field, Mexico City's central airport. Lake Texcoco can be seen beyond field. Mountains in distance are 11,000 ft. high.

(PAA and Cia. Mexicana photos)

By JUAN NOLAN C.

Below the border—where the airman finds high altitudes "make things happen faster"—there's plenty of room for both pleasure and profitable flying. But, says Author Nolan, the crying need for aviation facilities continues to be a barrier.

PILOTS CONTEMPLATING A FLIGHT to Mexico City will be smart if they brush up on their knowledge of thin air. For here, with a takeoff altitude of 7,300 ft. and required ceilings of 11,000 or more, just to ease over the lip of the cup which is the Valley of Mexico, one must know the vagaries not only of thin air, but of strong up-drafts, down-currents, and other quick changes in the peculiar, unseen element which keeps us aloft.

So here we fly high as a matter of course, and the air is light as the proverbial feather. All pilots know that the higher one takes an airplane, the more it runs out of power. All know the reverse, too, that the heavier the air the better our airplane behaves and responds. Yet here, despite the drastic changes (as compared with what pilots in the United States of the North are used to) flying requires no special trick or unusual aptitude to accustom oneself to local conditions.

These local conditions are neither new nor different, they only require a more precise type of flying—demand alertness backed by a sound understanding of the makeup and behavior of the particular air in motion above this tableland.

Only one warning for such projected flights: Don't pick up any new ideas of what to do, or how to do them. The same principles of flight as one learns during his training period, obtain down here (or up here, if you will), as obtain at sea level. The only difference is that things happen much faster. Instrument readings remain the same and the pull of gravity does not vary. This is a great advantage, for it will aid the newly arrived pilot in that he does not have to change his reactions, only just speed them up. Even so, his takeoff runs will be much longer and his landing glides much shorter. The landing speed increases, but he will never know it by his instruments, for at altitude the airspeed indicator will show "regular," which is actually too low.

High altitude flying has many advantages, particularly through the economies effected in gasoline consumption. Take for example the small personal plane making a flight between Mexico City and Acapulco. Without a reserve gas tank and if faced with adverse wind con-

***Juan Nolan C.**, author of this article, is a North American who has resided for the past several years in Mexico City. President and general manager of Laboratorios Winthrop, S. A., he is a member of the University Club and of Mexico's oldest scientific body, La Sociedad Mexicana de Estadistica y Geografia, founded 114 yr. ago.*

Having received his flight training and ground school education under Mexican instructors, he is a qualified Piloto Privado, holding license No. 590. His knowledge regarding aviation facilities, cross-country operations, and equipment throughout the Republic has been gained through personal experience with local conditions.

Mr. Nolan is convinced that "post-war flying in Mexico presents more opportunities for more people than any other part of the Western Hemisphere, with the possible exception of Canada". His avowed purpose is to awaken this understanding, particularly among the Mexicans themselves, so that the end of the war will find them ready to take advantage of the possibilities which lie ahead.

Demanded in Mexico, says author, is "a more precise type of flying," and this view of airport at Acapulco emphasizes his statement. Air currents must be conjured with in operating from this strip between mountains and water. Note tortuous ravine approach from east.

ditions, it might be necessary to come down in Chilpancingo for more gasoline (assuming that altitude is maintained at ordinary levels in accordance with the contour of the country). By this time one may want a faster airplane or one with a longer range. As it is, one stands to lose time, maybe an hour, if gasoline isn't handy, and besides adverse conditions may get worse. Yet from Chilpancingo one needs only 40 min. more to complete the flight.

But, if your airplane engine regularly consumes 20 gal. for every hour of flight at ordinary levels, and after leaving the Valley of Mexico one can fly at these ordinary levels—then by going to 10,000 ft. one can stretch the gasoline supply to obtain 30 (not 20) miles per gallon. In short, higher flying—farther traveling.

It is all really very simple and based on the economics of high altitude flight. Your engine, running high in the sky, just uses less gasoline, thats all. It loses some speed, it is true; but this is offset by increased distance obtained per gallon of gas. Here is one place where one actually obtains something for nothing. Instead of landing in Chilpancingo (as in the example above) for needed gasoline, one can, by flying at a constant altitude of 10,000 ft. arrive in Acapulco in a little more time, but with more than enough gas to spare.

Thus the advantages of flying in high altitude conditions (by necessity obtaining in most of Mexico) are more than offset by the slightly higher horsepower required here than in sea-level conditions —with accordingly higher landing speeds and the "hotter" flying which this high altitude requires of pilot and plane.

Because of the thin air prevailing in the mountainous regions throughout Central Mexico, visibility conditions are for the most part excellent. Added to this, the marvelous landmarks in the form of three-mile-high volcanoes (there are three of these three-milers, count 'em) each with snow covered peaks, allow the average pilot to soon recognize his location and judge his heading.

Mexico's climate, at least that half which is affected by a backbone line drawn from North to South through its approximate center, is ideal all the year 'round. Storms which arise only between October and April are mostly confined to the East Coast and take the form of *nortes* originating around Vera Cruz. Because of the long, high-level Sierra Madre range running north and south, these *nortes* seldom carry their effects to the western side of the range. For this reason open flying obtains practically all year in the sizable area bounded on the north by the U. S. frontier, on the south by Guatemala, and to the west by the Pacific Ocean. For this reason also, nearly all the tourist travel to seaside and vacation spots is toward the west.

Recently the writer, without making detailed inquiries as to flying conditions (although the newspapers ran stories of storm damages on the East Coast), decided to fly to the Isthmus of Tehuantepec. Inquiries at the field revealed that a strong *norte* was blowing and that the run to Vera Cruz was closed in. Despite strong adverse weather conditions, which at times ranged no more than 20 mi. parallel to the true course, he was able to fly by way of Oaxaca under ideal conditions. Only upon arrival at Ixtepec, the end of the run, had the wind increased in velocity, due to the funnel shape of the Isthmus itself, but this wind was still lowered somewhat by the same friendly range of mountains which here acquires the name of Continental Divide.

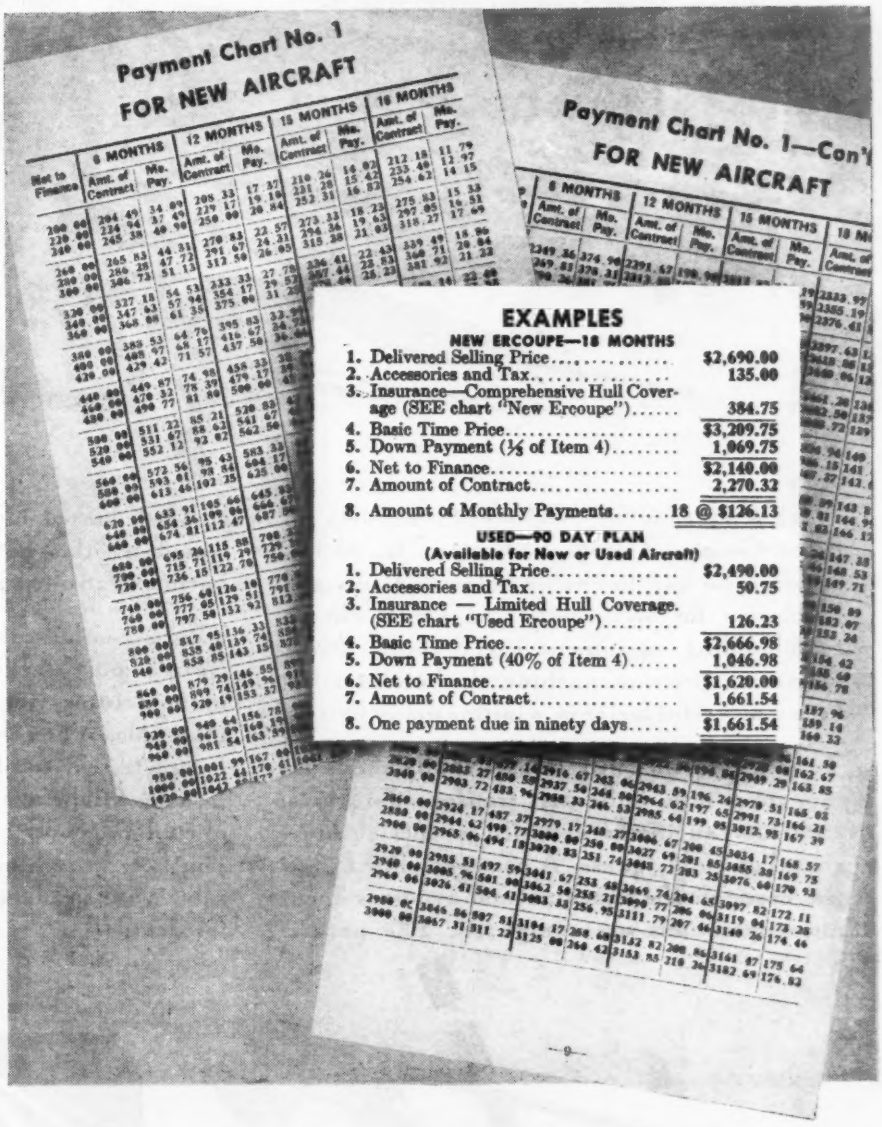
The now-ancient art of barnstorming disappeared from flying's last outposts in the United States quite some years ago. But its sun has not yet set in Mexico. During the trip described above, and after arrival and a night's rest in Ixtepec, your correspondent set out next day for an isolated spot variously called Jesus Carranza or Santa Lucrecia. Though this is a well known railway junction town (here meets the branch line from Puerto

(*Turn to page 276*)

Too many Mexican airfields continue to be cursed by poor facilities, declares Mr. Nolan. Important centers, he says, still afford only grass runways and temporary maintenance equipment flanked by barreled gasoline, as exemplified by shots of old Carmen airport (below, right) prior to its modernization. As seen left, Carmen layout, which serves CMA line, PAA subsidiary, is now up to date. It has mile-long concrete strips, underground fuel tanks, radio and meteorological stations, and complete lighting supplied by its own generating plant.

Parks Plane-Buying Plan Combines Time Payments, Insurance

Arrangements including participation by bank and insurance underwriter sets pace for postwar personal plane financing on local basis.


Payment Chart No. 1
FOR NEW AIRCRAFT
Payment Chart No. 1—Con't
FOR NEW AIRCRAFT
EXAMPLES
NEW ERCOUPE—18 MONTHS
1. Delivered Selling Price..... $2,690.00
2. Accessories and Tax..... 135.00
3. Insurance—Comprehensive Hull Coverage (SEE chart "New Ercoupe")..... 384.75
4. Basic Time Price..... $3,209.75
5. Down Payment (⅓ of Item 4)..... 1,069.75
6. Net to Finance..... $2,140.00
7. Amount of Contract..... 2,270.32
8. Amount of Monthly Payments.....18 @ $126.13
USED—90 DAY PLAN
(Available for New or Used Aircraft)
1. Delivered Selling Price..... $2,490.00
2. Accessories and Tax..... 50.75
3. Insurance — Limited Hull Coverage. (SEE chart "Used Ercoupe")..... 126.23
4. Basic Time Price..... $2,666.98
5. Down Payment (40% of Item 4)..... 1,046.98
6. Net to Finance..... $1,620.00
7. Amount of Contract..... 1,661.54
8. One payment due in ninety days..... $1,661.54

A COMBINED time-payment and insurance plan for the purchase of personal aircraft—a plan pointing the way to local financing and coverage—has been put in operation by Parks Aircraft Sales & Service, East St. Louis, Ill., in conjunction with the Manchester Bank and General Insurers, Inc., both of St. Louis.

An integral part of the plan sets forth rates which will reduce insurance costs from 35 to 50 percent on purchases of new and used Ercoupes, for which the Parks organization is Midwest distributor. These rates, according to C. J. Muckerman, head of General Insurers, were figured on the basis of the craft's spin-resistant two-control characteristics.

Said to be unique is a feature of Ercoupe plan under which members of the purchaser's immediate family, or any certified pilot having permission, may fly the craft without increased insurance rates. Thus the policy may cover flight activities of several individuals in contrast with other policies under which only the purchaser or other specified individuals are protected.

The purchaser may select any of three types of policies: Limited hull coverage, written specifically to fit the Ercoupe; named peril coverage, limited to stated risks on the craft; and, comprehensive hull coverage, which is approximately the same as the so-called all-risk policy of standard aviation insurance, the broadest coverage which is written on personal planes.

Limited hull rates are reported as $4.50 per $100 of insurance, named peril $6.50 per 100, and comprehensive hull $9 per $100.

In addition, coverage may be obtained at standard rates for liability and property damage and passenger liability when the planes are not operated for hire.

The Manchester Bank has prepared a booklet for salesmens' use giving details on: procedure of aircraft financing; general instructions on use of time payment contract forms; limitations and requirements of such contracts; examples of 90-day and 18-mo. contracts on new and used Ercoupes; insurance plans for that craft; insurance term definitions; procedure for financing craft other than Ercoupes; payment charts for 90-day, 6- and 12-mo. contracts on both new and used craft; hull insurance premiums on both new and used Ercoupes and other aircraft types; passenger, liability, and property damage premium tables; and prewar new list prices covering more than 250 different models of aircraft.

Procedure on financing, for examples, is given in the following steps:

First, set up delivered selling price; and accessories (if any) and tax; add insurance; total these three items to arrive at the basic time price; calculate the down payment (33 1/3 percent on new craft, 40 percent on planes over six months old); subtract this item from the basic time price to determine the net amount to finance; establish, from old and new model payment charts, the total contract amount; establish amount of monthly payments according to length of the contract.

Additional steps give instructions for setting up the purchaser's credit statement; advising him on insurance; arranging even-amount time payments; dispatching the contract for credit investigation; and, finally, drawing draft on the bank.

Putting "Hep" IN THE "CATS"!

NEWSWEEK of August 28 reports of Lieut.-General George S. Patton, Jr., as follows: "If he had to choose between tanks and bulldozers for an invasion he would choose road-building equipment every time." More than a construction machine, the bulldozer has been a powerful factor in winning many battles.

To quickly, efficiently fit axle shafts and bearing cups into bulldozer transmission cases, *American* engineers designed a special horizontal assembly press. A conveyor line brings the cases to the machine and removes them after operations are completed. The part is stopped, locked in position, pressed, and released by this hydraulically operated, push button controlled machine.

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Canada Sets Up Beam-Approach Flight School

By **JAMES MONTAGNES,** *Canadian Correspondent, "Aviation"*

New training course gives technical and flight instruction to Commonwealth Training Program pilots in concentrated effort designed to make them "weather free" fighters.

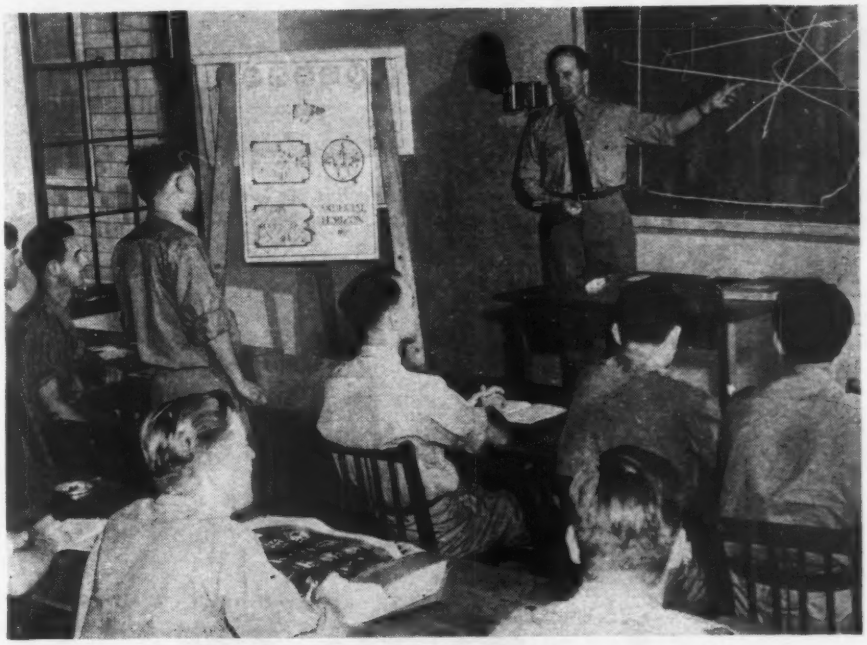
APART of every Royal Canadian Air Force pilot's training today gives him the ability to return to his home airfield and land safely, no matter how black the night or dense the fog. This skill is taught at the RCAF's recently established beam approach training school at Deseronto, Ont., where World War I pilots learned to fly a quarter-century ago.

The new training station, first instrument flying training school to be set up in Canada, is claimed by the RCAF to be the only school among the Allied Air Forces to combine on one station courses in beam approach, beam approach technical training, and Link trainer. It is staffed by veterans of bombing missions over Germany and by top-flight instructors from the RCAF and RAF.

The school is turning out instructors in beam approach flying for all twin-engine service flying training schools across Canada so that bomber pilots graduating under the British Commonwealth Air Training Plan will be well grounded in this newly developed method of "homing" and controlled "let down" while they are still in the training stage. Moreover, the school is turning out Link trainer instructors and maintenance crews for the installation and repair of aircraft and ground equipment used for beam approach radio communication.

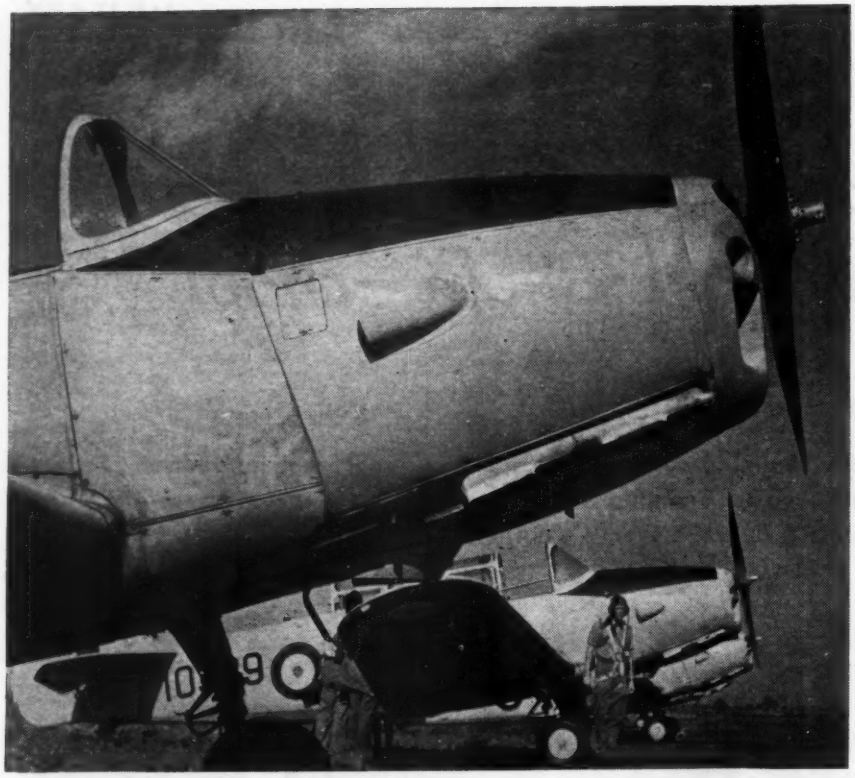
The Deseronto station had the first beam approach equipment in Canada; as a result, on days when aircraft at other fields in the Dominion were kept to the ground by low-hanging clouds and fog, aircraft were flying there day and night. Icing is virtually the only flying hazard feared, for it renders aircraft unserviceable and is apt to freeze over the instrument apertures.

At first regarded as a sort of black magic which only super-pilots could master, the beam approach system can be learned by anyone who can fly on instruments. The course is short, requiring only two weeks. Of this, about 40 hr. are spent in the air. Trainees are first con-



Every phase of flying control is taught at RCAF's new beam-approach school at Deseronto, Ont. Here Squadron Leader J. C. Edwards lectures a class on interceptor control. (All RCAF photos)

Link training is an important part of Canada's instrument flight training school, under which all pilots in Commonwealth Training Program get every available aid in learning to fly safely through any kind of weather they may meet in actual operations. Link trainer instructors and maintenance men, as well as pilots, are trained at new school.



Men achieving high standings in training as Link instructors are given actual flight training up to solo stage in Fairchild Cornells, here shown on line at No. 1 RCAF Instrument Flying Training School.

verted to flying the twin-engine Oxfords used at Deseronto. Then they take a few hours of instrument flying as a refresher.

Flying by day "on the beam" and practising the proper turns for the "let down" are the next steps. During this period the students are actually flying blind, with a canvas hood shutting out landmarks on the pupil's side of the aircraft. The instructor's side is left clear to forestall mid-air crashes. Next they do night flying by instruments, one of the most important phases of the course.

Here is how the beam approach system works: At the end of the longest runway at Deseronto is a transmitter throwing a long narrow high-frequency radio beam which slants upwards. Only 1½ deg. wide, it has a range of about 100 mi. at 4,000 ft. When the pilot is squarely on the "front beam" (as it is termed when the heading is into the home station) he hears a steady monotone through his earphones. If he swings off course to the left, he hears a series of dots. If he swings off to the right, he hears dashes. On the instrument panel is a visual indicator which gives his eyes the same information as his ears receive through the earphones.

Cruising at 600 ft. on the beam, he receives a distinctive signal when crossing the "outer beacon", a vertical cone of radio rays which intersect the directional beam 2 mi. from the end of the home runway. He begins to descend at a standard rate to cross the "inner beam" at 100 ft.. Here he levels off and approaches the runway in the correct position for landing. The beam brings him down within 50 (or even 25 ft.) of the runway.

With the beam approach equipment, pilots will tackle landings when they have only 100-yd. visibility and 50-ft. ceiling conditions, which would be foolhardy to anyone flying contact. Learning the correct technique in making the proper turns and calculations, the flyers must be drilled in the procedure until they are letter perfect. They also must be well-versed in reading instrument, for they have nothing else to guide them in judging where they are or how high they are from the ground.

The beam approach equipment has played an important part in bringing home the bombers from the big raids over Europe, day and night, in good weather and bad. And just as important in take-offs has been the training given bomber and fighter pilots in Link trainers. As chief Link instructor, Squadron Leader J. C. Edwards, who has seen service at British and African operational stations, explains:

"Pilots must know perfect procedure in taking off and landing on the big bombing raids, and it is the Link trainer which constantly brushes them up. Can you imagine what would happen with 1,000 bombers landing or taking off in a period of 45 min.—unless we had perfect procedure ingrained in our pilots by means of Link training? Chaos would result."

That is why a "good Link instructor is worth his weight in gold on an operational station," the RCAF points out. And at the Deseronto school Link instructors are turned out to take posts at other training stations throughout Canada. The Link trainer follows RCAF pilots from their first few weeks in uniform throughout their service careers. They take Link training at the manning depots and in between bombing raids at operational stations. No pilot is ever so good that he can avoid sharpening his skill on the Link.

At Deseronto, Link instructor students need not be able to fly service aircraft, although there are numerous students who flew in World War I. In the first two weeks of the course, embryo Link instructors learn elementary subjects, such

(*Turn to page* 276)

Wing Comdr. E. F. MacDonald (left), Deseronto's commanding officer, with Squadron Leader H. Gibson, chief flight instructor, maps a training flight for instrument school's student pilots, who learn both theoretical and practical aspects of instrument flying.

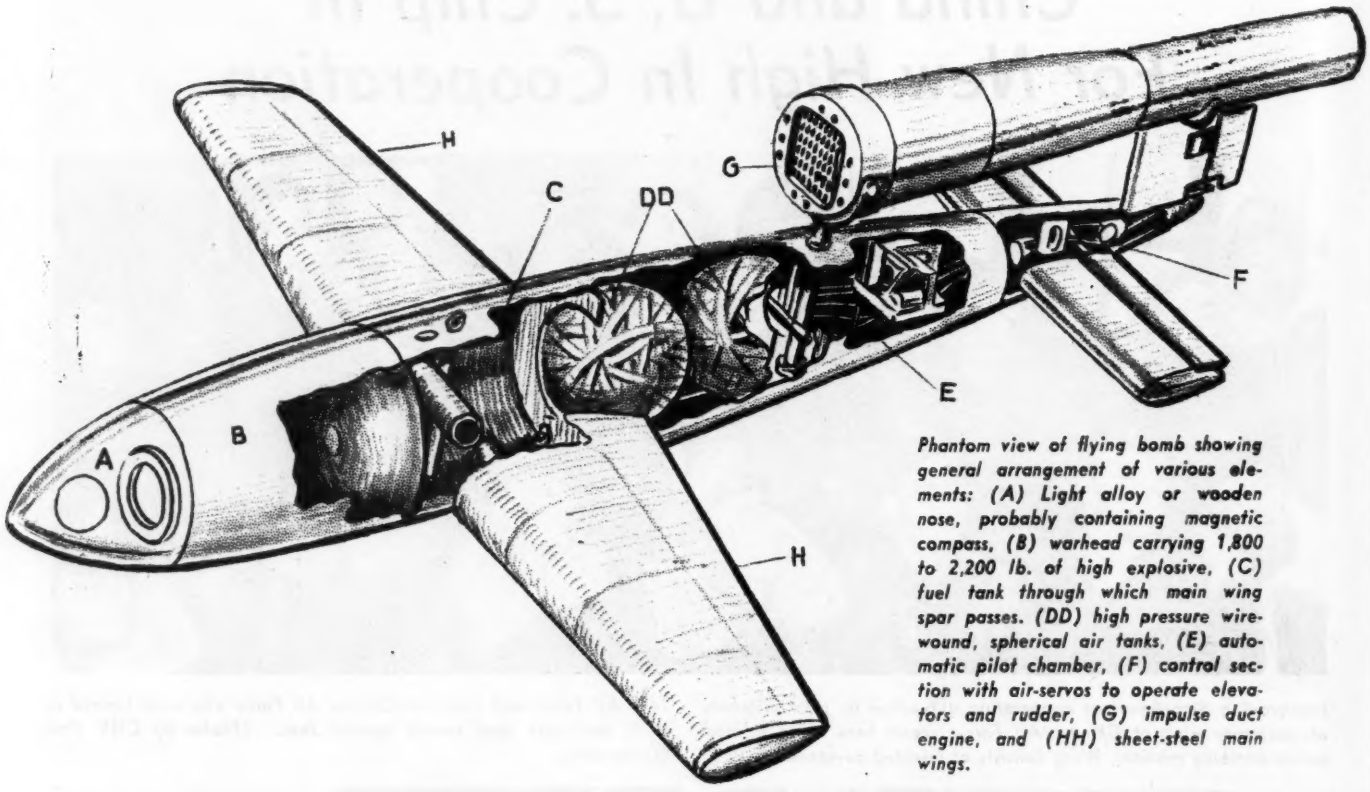
China and U. S. Chip In For New High In Cooperation

Ever-growing Sino-American cooperation is typified by pilot members of composite wing of Chinese Air Force, shown here being briefed before bombing mission. Wing consists of selected personnel of U. S. 14th Air Force and pilots of Chinese Air Force who were trained in U. S. and have seen service against Japs. (Photos by CNS, Paul Guillumette)

Co-commanders of bomber group of Chinese-American composite wing are Maj. Lee Hsueh-Yuen and Col. Irving Branch. Wing is commanded by Maj. Gen. Claire L. Chennault and is equipped with hard-hitting B-25's and late-model P-40's.

Chinese and American mechanics comprise ground crews of composite wing. Here, American and Chinese field men work together on maintenance problem. Language differences have been quickly overcome, hence have been no barrier to efficient maintenance.

At base somewhere in China, fighter group pilots of composite wing "scramble" for their P-40's at signal for another dual-nationality mission against the Japs.



Phantom view of flying bomb showing general arrangement of various elements: (A) Light alloy or wooden nose, probably containing magnetic compass, (B) warhead carrying 1,800 to 2,200 lb. of high explosive, (C) fuel tank through which main wing spar passes. (DD) high pressure wire-wound, spherical air tanks, (E) automatic pilot chamber, (F) control section with air-servos to operate elevators and rudder, (G) impulse duct engine, and (HH) sheet-steel main wings.

Design and Construction Of Nazi V-1 Flying Bomb

By CHESTER S. RICKER, *Detroit Editor, "Aviation"*

Presenting heretofore unrevealed details of one of this war's most destructive weapons—what it is and how it works.

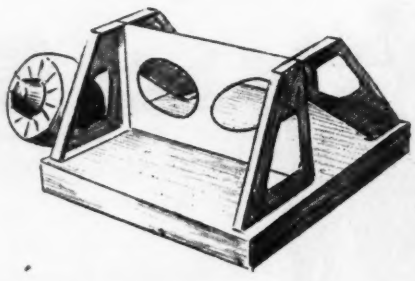
WITH SKETCHES BY THE AUTHOR

SIX DAYS after the Allies had invaded Normandy, the first flying bomb hit England—to introduce one of the most destructive single weapons of the war. And subsequent capture of the so-called rocket coast did not stop them.

Although a war weapon, the V-1 bomb is of even broader interest to aviation men because of the all-steel construction, robot controls, and impulse motor.

Examination of parts and a full-scale model of V-1 disclose many interesting structural details and indicate quite clearly the probable method of the control and the operation of the engine. However, as far as possible deductions of this correspondent will be carefully indicated.

Aerodynamically the robot bomb is an all-steel mid-wing type monoplane with an impulse duct engine mounted about 30 in. above the fuselage. The use of sheet steel unquestionably adds to the ease and rapidity of fabrication and also reduces the cost.

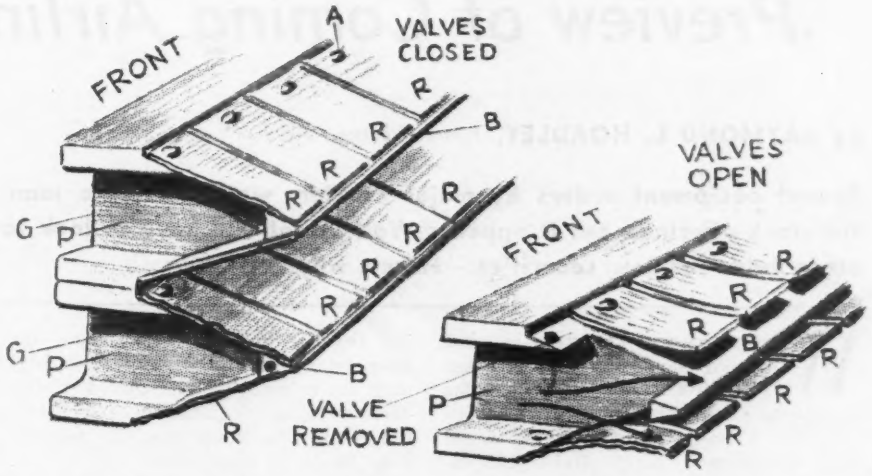


Pressed steel frame in which two air driven gyros are mounted. At left end is adjustable dial graduated, apparently in meters. This probably is used for setting maximum flight elevation.

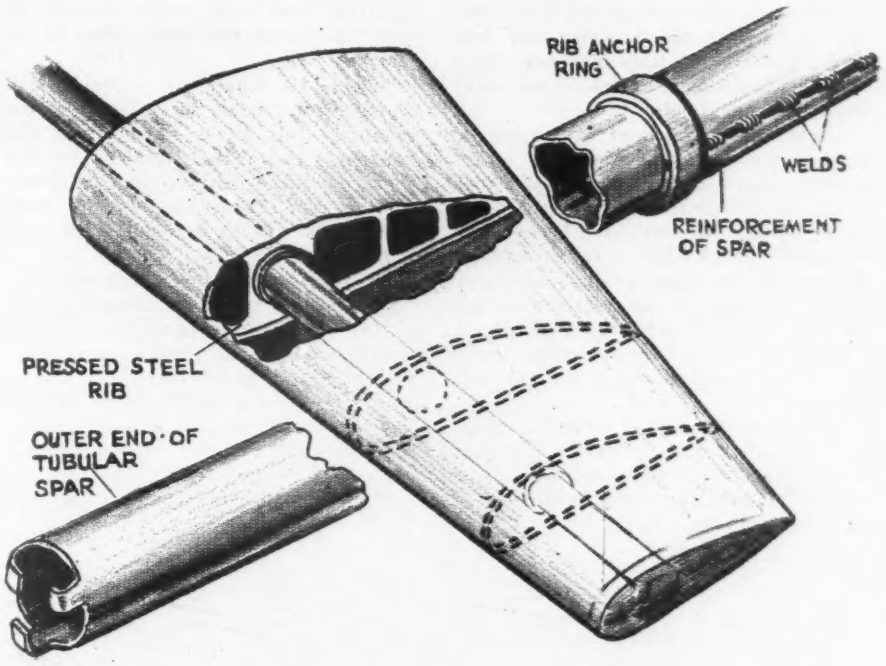
The complete V-1 unit may be roughly divided into eight major sections: The nose, warhead or high explosive carrier, wing and gas tank, compressed air chamber, automatic pilot, its compartment, empennage unit with air-servo controls, and the impulse duct engine.

According to various press reports, the nose is made of wood or a non-magnetic alloy so as to accommodate a magnetic compass. Since the rest of the structure is all-steel a compass could not be used inside it. There are also reports that a radio device is contained in the nose. This might be used to establish the position of the bomb when it starts its final dive, and radiosonde such as used in meterological balloons could easily be adapted for that purpose. It is, as a matter of fact, difficult to understand why the bombs are not radio controlled, for the extra weight apparently would be no handicap. Perhaps it is because the British counteract the radio control.

Probing of grill suggested this concept of valve mechanism. Reed valves (R), similar to those used in a harmonica, are arranged on back of each grill section, probably riveted or welded to grill section (G). When open they allow air to flow in, as shown by arrows. Valve seats are probably connected by bridge (B), and fuel jets may be located here also so that fuel is fed only when valves are open.



Below: Sheet-steel wing structure. No ailerons are provided. Wing tip is welded to end. Pressed steel ribs are apparently welded to tubular spar extending from tip to tip. Spar is seamless tube from end to end with lugs for welding to wing tip at each end. Center section has strip of steel rolled around tube and spotwelded in place. Bands are welded at rib attachment points.



Apparently the Nazis equip the bomb with a dry-battery-powered electric system for ignition purposes and for direction control, since there are wire connections on the automatic pilot unit. If there is a pilot compass in the nose, it would probably be connected by wires to the rudder or azimuth controlling gyro. On the bomb studied there was no connection between the automatic pilot and the rudder, since the latter had been torn off the fuselage. However, there is a graduated dial on the automatic pilot. It is not graduated in degrees, but there might have been a control that could be pre-set to determine the heading or course of the bomb after launching.

The space immediately in front of the wing contains the explosive. This section is conical, varying from about 24-in. dia. at the front to 30 in. at the rear end. It is about 4 ft. long, and in it go 1,880 lb. of high explosive.

The third section is most interesting because the fuel tank and wing are built together as an integral structure. The fuel tank is cylindrical, of about 32 in. dia. and 44 in. long. The main wing spar passes through it, as does the lifting tube which is attached at the bottom to the launching shoe, and there is provided a detachable lifting eye at the top. This is apparently close to the center of gravity of the unit as well as to the center of lift of the wing.

Since the 130-gal. (probably Imp. gal., equivalent to 162.5 U. S.) fuel tank is also located at this same point, the balance of the bomb should not be affected as

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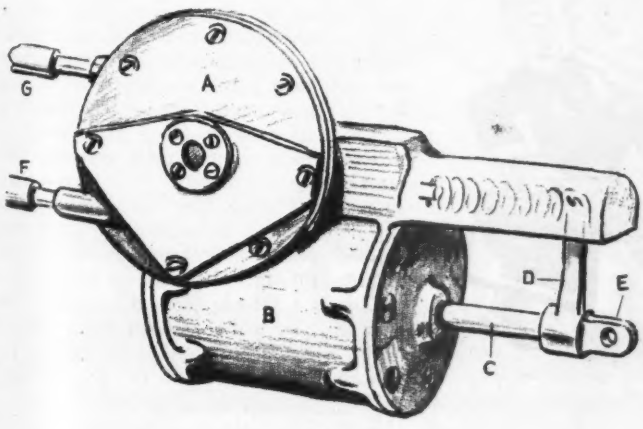
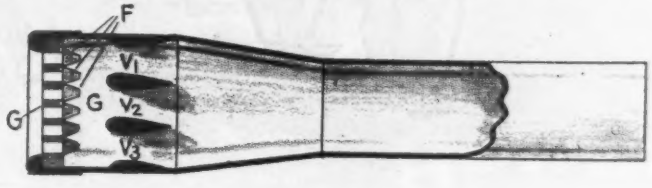


Left: Sketch shows arrangement of valve controlling diaphragm (A) on side of air-servo cylinder (B). Piston rod (C) is connected to an arm (D), which in turn is connected to piston valve by spring. End (E) of piston rod operates elevator or rudder. Tubes (F) and (G) connect diaphragm to automatic-pilot gyro. Below: Cross-section view gives author's conception of impulse tube engine. (G) is steel grill in front carrying steel reed valves (F) on aft side. Combustion chamber is probably at (C). Three venturi passages, V_1, V_2, and V_3 probably are not tubular, but formed by airfoil vanes. Whether they are vertical or horizontal, if used, is not known.



Preview of Coming Airline Financing

By **RAYMOND L. HOADLEY,** *Financial Editor, "Aviation"*

Recent equipment orders by major carriers would indicate some fat stock offerings, but it appears Wall Street will have to look to other fields for new securities. Here's why.

WHEN THREE AIRLINES recently signed contracts to purchase $50,000,000 worth of Douglas transports, Wall Street immediately figured that a major bit of financing would soon be coming its way. And stockholders, too, may have presumed that large capital stock issues would be floated according to past custom.

But actually the airlines won't need to worry about additional funds until the late summer of 1945, maybe not even then if they are willing to use growing cash resources to take care of early deliveries. And when the financing day does come, some of the lines may veer quite sharply from the old accepted pattern for obtaining new funds.

Obviously the airlines are going to need money, since the equipment orders already placed exceed their liquid cash resources. Estimates of postwar capital needs for the industry have been placed as high as $800,000,000—a rather staggering sum for an industry whose aggregate capital structure is not as large as any one of a dozen big industrial corporations. That much money may be needed, but it will only be needed over a period of ten years or so.

Meanwhile there are a number of reasons why airline executives are not rushing to the bankers for additional funds just yet. In the first place, initial deliveries of the Douglas and Lockheed planes they have on order probably will not begin until six or eight months after V-E Day. Moreover, cash is piling up to the extent that some lines could postpone financing even longer if they wish.

The fact is that earnings today are so good that airlines can finance a greater portion of equipment needs out of their treasuries than they thought possible even as recently as six months ago. There was an alarming dip in earnings early this year. Then the lines tightened up on operating costs while traffic mounted as more planes were returned to them by the Army.

United Air Lines, for example, disclosed net income of 50c. a share in the month of July alone, thus earning the company's entire 1944 dividend in that 31-day period. Other lines, showing quite similar gains, are plowing these profits back into the business in the form of liquid assets.

The result of these accumulating earnings, plus conservative dividend policies, is that some of the lines are changing their thinking on future financing methods. Present prospects are that there will be fewer stock issues floated, more reliance on bank credit, and not as much use as might be expected of the equipment trust method so successfully employed by the nation's railroads for many years.

Here is the situation as it seems to be shaping up at this early date for the "Big Four" domestic airlines:

American Airlines officials point out that up to 70 percent of the line's $30,000,000 present commitment for Douglas DC-4 and DC-6 transports could be financed by cash if the company so elected. But when deliveries really get under way late in 1945, American probably will finance a substantial part of the purchase through bank credits or possibly through equipment trust certificates. The planes would be written off in depreciation in six years, and the obligation likewise could be repaid out of earnings in about the same length of time.

Eastern Air Lines may choose to pay straight cash for its contemplated purchase of $7,000,000 of transports. Eastern has never paid a dividend, preferring rather to steadily strengthen its finances for future expansion. The result is that Eastern at the end of 1943 had cash items of $16,500,000 and net current assets of more than $13,500,000.

United Air Lines has about $19,000,000 cash in the till today, and its position will be better by the time payment must be made for the $25,000,000 in transports that have been ordered—all due to additional profits that will accrue between now and delivery dates. Last year United sold $10,000,000 of preferred stock to acquire a reserve preparation of postwar development. In the future the company will probably rely on bank loans in the form of chattel mortgages.

TWA officials forecast that the company's capital requirements by 1954 for domestic operations will total around $100,000,000. The company has turned to bank loans to finance plane acquisitions, and it is expected that this method will be employed in the future, since some of the company officials are known to be opposed to the use of equipment trusts.

Thus it appears that the major lines may favor direct bank loans when the time comes to raise money. In fact, a large number of banks already have indicated their willingness to make such loans for equipment purchases. And the reason for this new interest in airline loans on the part of bankers stems from the excellent credit rating their strong cash position has given them. It is known that some banks are willing to provide credit for 75 percent of equipment cost, an amount that can be easily handled by the airlines through depreciation charges.

This is a far-cry from the situation in prewar days when bankers turned their backs on American Airlines' efforts to finance its first fleet of DC-3's, the line

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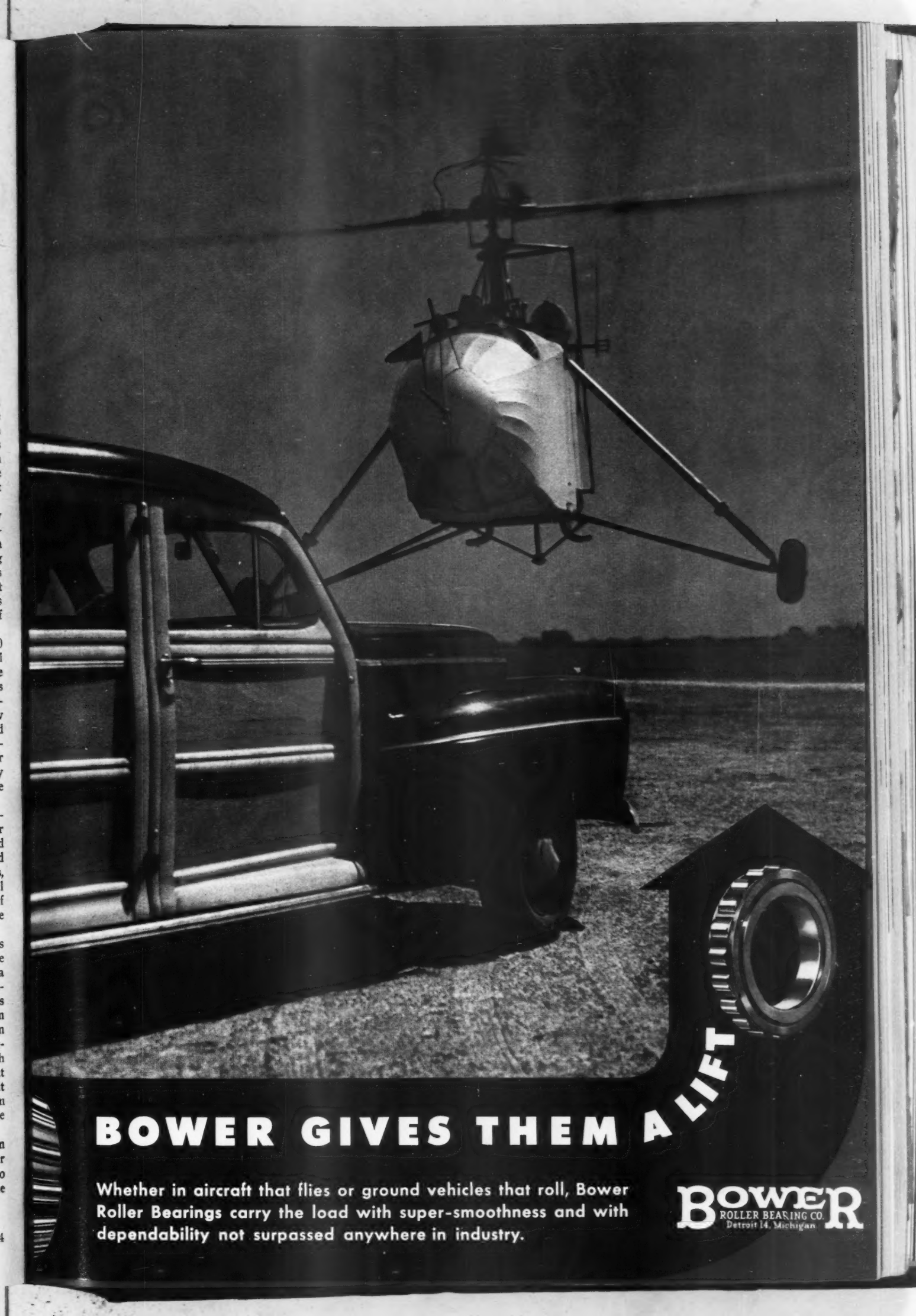
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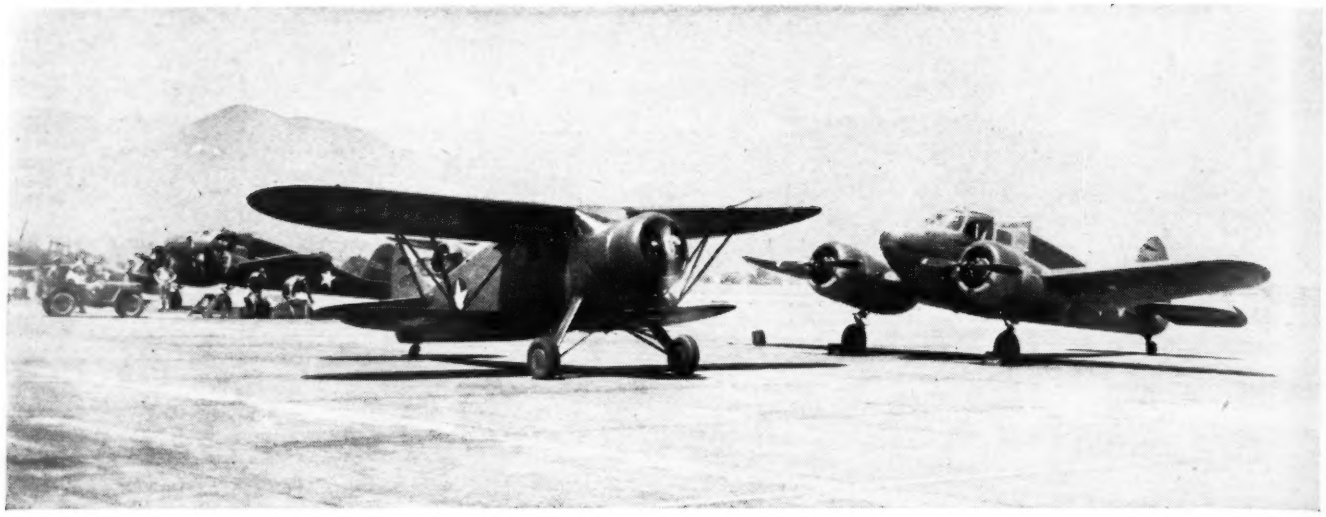

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The "ups and downs" of this service, over 2600 route miles per day, totalled 28,000 landings and take offs. Loads consisting of war materials with high priorities, military freight and mail demanded the utmost in dependable service at all times. Champion-Ceramic Spark Plugs played their vital part with conspicuous success as attested to by the above excerpts.

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NOVEL LIGHTWEIGHT JUNCTION BOX COMBINES ACCESSIBILITY AND VISIBILITY

A PLASTIC ELECTRIC JUNCTION box, developed by Harry Cramer, Martin engineer, is considerably lighter and affords greater ease of inspection and maintenance than standard metal boxes.

Design of the new box provides for either a metal or laminated plastic flat base (depending on whether or not ground studs are needed in the assembly) as the main section to which installations and wiring are attached. The molded cover of transparent plastic, developed by W. A. Safka, Martin plastics engineer, requires only a single, low-cost cavity mold; forming is done with air from flat sheet heated to 380 deg. F.

With the conventional type box, installations are made in the box proper and are less accessible during assembly and maintenance than with the new unobstructed flat surface.

Another improvement of the new design is the reproduction, by photographic process, of the wiring diagram on the sensitized base plate. This not only simplifies drilling, assembly, and wiring of the units during manufacture, but also provides a permanent record for use of maintenance personnel in the field.

The transparency of the cover adds to the man-hour savings during manufacture and in the field. For example, with the metal box now in use in the center wing section of the PBM-3 *Mariner,* it is necessary to remove and replace the cover as much as 23 times for visual inspection between original installation and airplane ground test. This operation is repeated numerous times in the field—but with the transparent cover it can be eliminated.

Weight savings with the new box are considerable, ranging as high as 33 percent per unit, depending on type of box and material from which the base is made. Whereas the design is presently intended only for the radio direction-finder junction box, it is equally applicable to other junction boxes in the plane. In aircraft similar to the PBM-3 *Mariner,* which uses approximately 100 boxes in its various electrical systems, this would result in a net weight saving of 35-40 lb., as well as reduction in material and manufacturing costs.

New lightweight plastic junction box. It was developed by Harry Cramer, Martin engineer, who is seen here displaying unit decked with transparent cover developed by W. A. Safka, another Martin engineer. Wiring hook-up, photographically reproduced on sensitized base plate, simplifies drilling, assembly and wiring during manufacture, also provides permanent record for field service personnel. Unobstructed flat base surface affords ready accessibility during assembly and maintenance.

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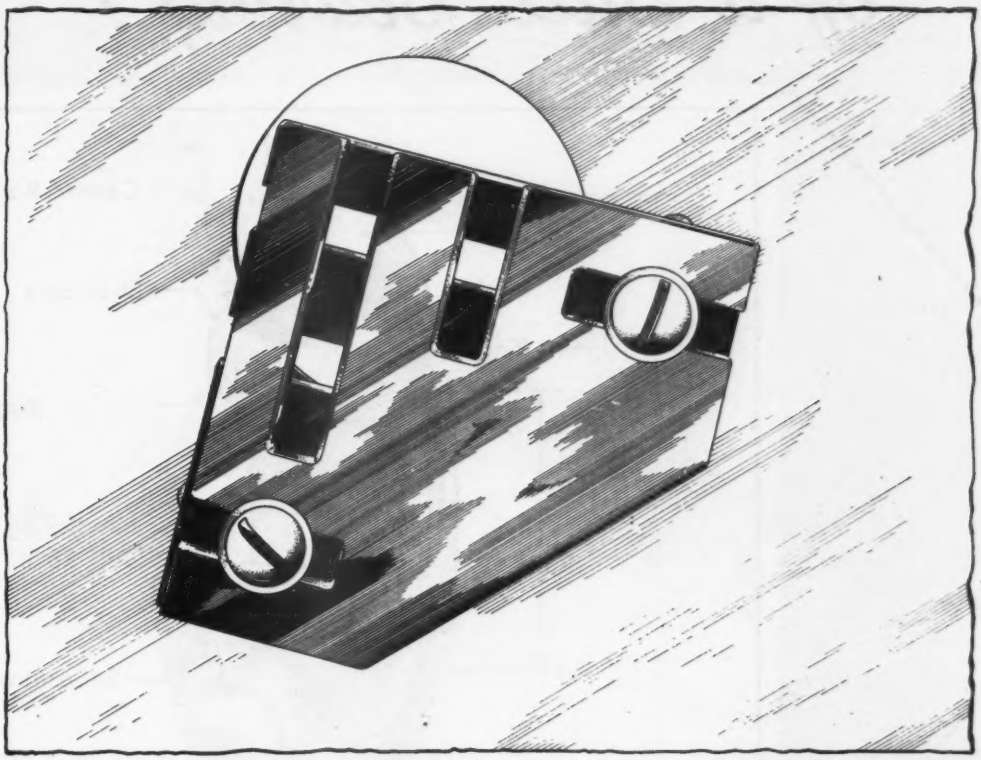


Fig. 1. Shown here is adjustable type fairlead for control cables, designed at Curtiss-Wright Airplane Div., St. Louis. Each block of assembly has parallel guide slots perpendicular to similar slots in other block to form criss-cross pattern of openings for cable run. Adjustable mounting, consisting of perpendicularly opposed anchor slots and screws, allows for radial adjustment to compensate for slight misalignment when cable fails to conform exactly to predetermined centerline location, and friction is thus reduced.

TWO INGENIOUS AND EFFICIENT fairleads for aircraft control cables have been brought out at the Curtiss-Wright Airplane Div., St. Louis. One of these fairleads is an adjustable type; the other is a swivel type. Each has special features and range of uses, and both are simple in design, offering rapid adaption to cable conditions.

The adjustable fairlead (Fig. 1), designed by W. M. Scarborough of the engineering department, consists of twin blocks secured in superimposed relation on a bulkhead or other structural portion of the plane. The blocks, of 3/16-in. phenolic material or other suitable composition, are pentagonal—each having the form of a small square with an equilateral corner cutout. Each is provided with a pair of parallel cable guide slots, opening on the same side of the block and perpendicular to the guide slots of the other block, thus forming a criss-cross pattern of openings for running the cables.

The mounting of the assembly is rendered adjustable by perpendicularly opposed anchor slots on the respective blocks, affording radial movement with respect to predetermined cable centerline location —an advantageous feature, since cable installations frequently fail to conform exactly to given centerlines. Friction may thus be reduced to a minimum on long cable spans incorporating many fairleads.

The fairlead is installed by slipping one of the blocks over the cable, then slipping on the other block with the opposing guide slots to confine the cable in an opening of the criss-cross pattern.

Screws inserted in the opposing anchor slots secure the fairlead to the supporting surface, and serrated washers are used between the blocks to provide against vibrational displacement. Prior to tightening the screws, the blocks are moved until the bounding walls of the guide slot assume a position free from contact with the cable.

Motion of one block is always at right angles to the motion of the other. Thus the location of cable apertures may be varied over the area of the aperture in the bulkhead merely by linear movement of the blocks.

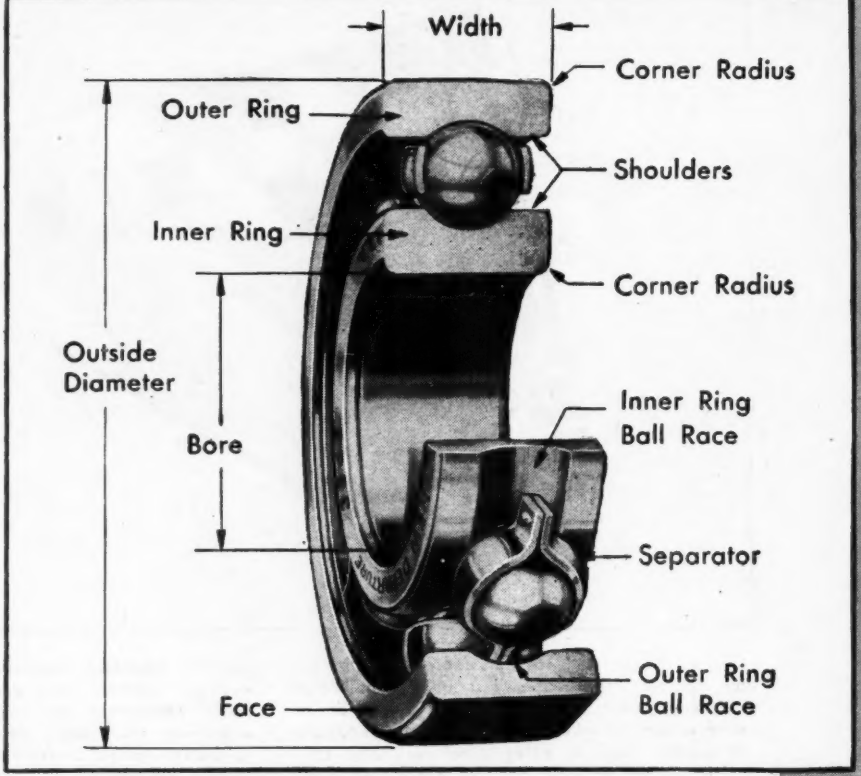
A novel swivel type fairlead (Fig. 2), designed by T. S. Lindabury, also of the engineering department, provides an effective restraining means for control cables and is particularly adapted to facilitate their rapid installation or removal.

This fairlead is a one-piece composition block molded in the form of a reel device with two horizontal arms. One of the arms is slotted for cable guidance and allows sufficient freedom of cable motion to minimize rubbing; the other arm is forwardly spaced and serves as a slot closure, restraining the cable normal to its length, to prevent escape.

It is unnecessary to remove the fairlead from its support when stringing a cable. The block is pivotally mounted on a pair of bearings carried on brackets secured to the supporting surface, and the swivel arrangement permits the slotted guide arm to be moved out of the zone of the cable so that large cable fittings may pass through the substantially larger rectangular opening between the horizontal arms of the block.

Only a simple manual operation is required to adjust the fairlead or remove it from a cable guiding position to one in which the cables are freed. The device is secured in the normal position by a small lockpin carried in an aperture provided in the side portion of the block and

Ever wonder about the anatomy of a Ball Bearing?



The subject of the Ball Bearing is on everyone's lips nowadays, because of its immense importance to the prosecution of the war.

But how many know what a ball bearing is—what it does—why it is so indispensable?

A ball bearing is not merely a steel ball! It consists of the assembled mechanism illustrated.

It is used wherever shafts turn, to support loads, to permit higher, smoother speeds. Because nothing rolls like a ball, it reduces friction and wear and assures that the precise "location" of machine parts is maintained.

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nothing rolls like a ball

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adapted to engage a mating aperture in the bracket. A spring element having one end anchored in the block engages the inner end of the lockpin. A finger loop on the outer end of the spring facilitates retraction of the pin when the block is to be freed for rotation. Upon completion of cable repair or replacement, when the block is rotated to its original position pin snaps into bracket aperture.

Should the cable be installed so as to lie in a direction not perpendicular to the rotational axis of the fairlead, the slots are given an angular set corresponding to the cable angularity.

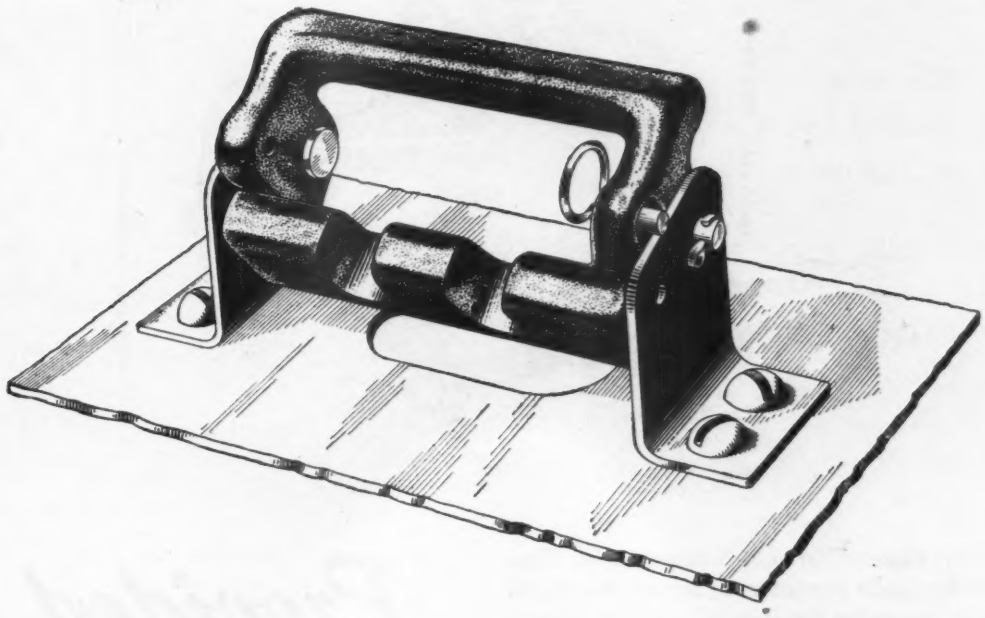


Fig. 2. Swivel type fairlead, also designed at Curtiss-Wright, is shown here positioned abnormally to depict details. Device is one-piece composition block, pivotally supported on bearings, with slotted arm for cable guidance and arm serving as slot closure. Swivel arrangement permits slotted arm to be moved out of cable zone to allow large cable fittings to pass through rectangular opening between arms. Spring-loaded lockpin secures block in cable-guiding position, and assembly is freed for rotation when pin is retracted by finger loop.

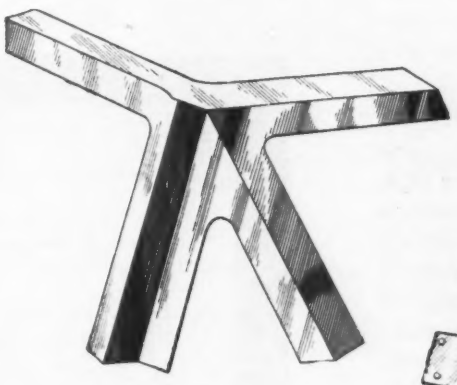
WELDING SIMPLIFIES JOINTS

WELDED JOINTS in a simplified design of PBM pilot house frames resulted in trim, watertight enclosures, and helped solve troublesome assembly and procurement problems.

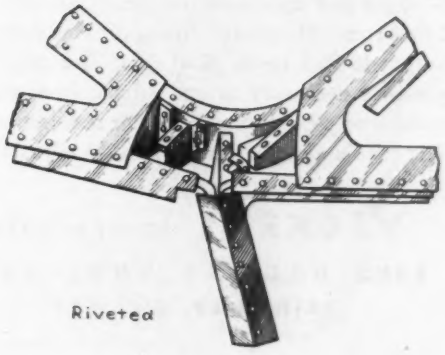
Original riveted frames presented difficulties with shape-holding characteristics after release from jig and during later assembly operations. Many structural members met at one point and required involved attachment details.

Using welded construction, uniformity is maintained in the complete assemblies. Four members meeting at the top corner post joint are neatly welded and crown skin is riveted directly to chord members. More than 60 detail parts are eliminated.

Welded design also provides savings in weight and material, and eliminates pockets which would accumulate corrosive salt water.



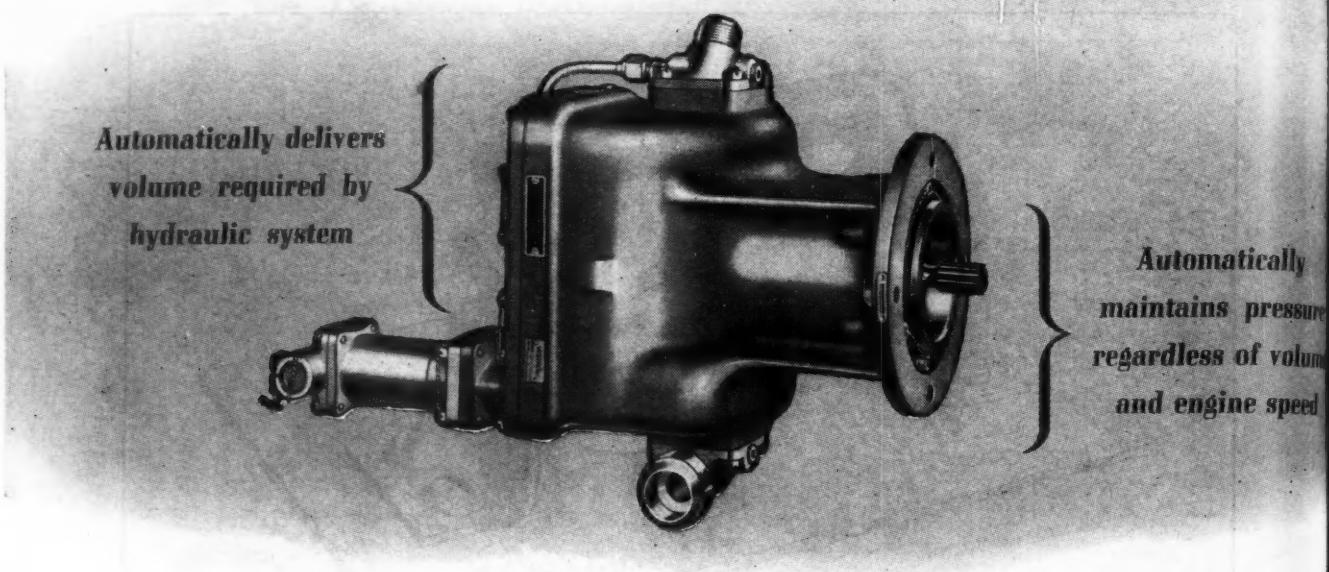
Welded



Riveted

HYDRAULIC POWER

FOR *Lockheed* CONSTELLATION


Automatically delivers volume required by hydraulic system
Automatically maintains pressure regardless of volume and engine speed

Four engine-driven Vickers Variable Volume Piston Type Pumps supply the hydraulic power for the booster system and the main hydraulic system on the Constellation. An integral part of this pump is a pressure control device that automatically and continuously maintains the desired pressure independent of varying volume demand and of engine speed.

This Vickers Pump automatically delivers the volume of fluid required by the hydraulic system. When the requirement decreases, the stroke of the pistons is shortened; when more volume is needed, the piston stroke is lengthened. Never is an excess of fluid pumped. The pump *maintains* full pressure in the system at all times with very little horsepower. The variable volume pump eliminates the necessity for the conventional accumulator and unloading valve required when a constant volume pump is used. The variable volume pump is recommended when hydraulic power is used continuously during flight . . . as for the flight control booster system.

As shown by performance curves, volumetric efficiency and overall efficiency are very high. Maximum recommended operating pressure is 1700 psi and maximum recommended speed is 2700 rpm. Maximum hydraulic horsepower output is 15.0 hp at 2700 rpm. The range in pressure necessary to cut volume from maximum to zero can be varied to suit requirements. The maximum pressure is readily adjustable.

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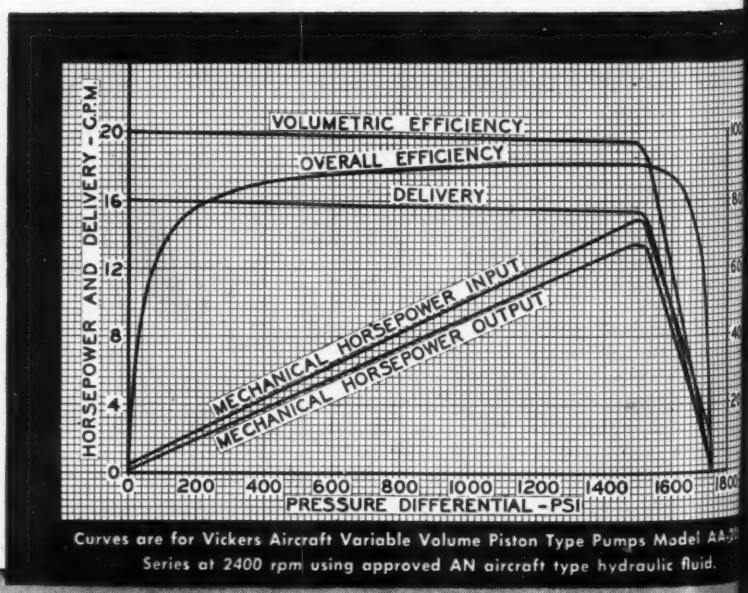
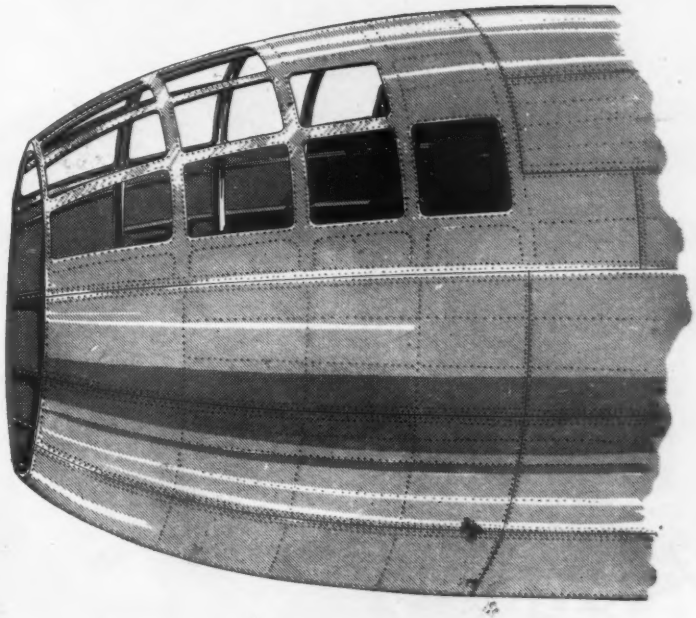
VARIABLE VOLUME PISTON TYPE PUMPS



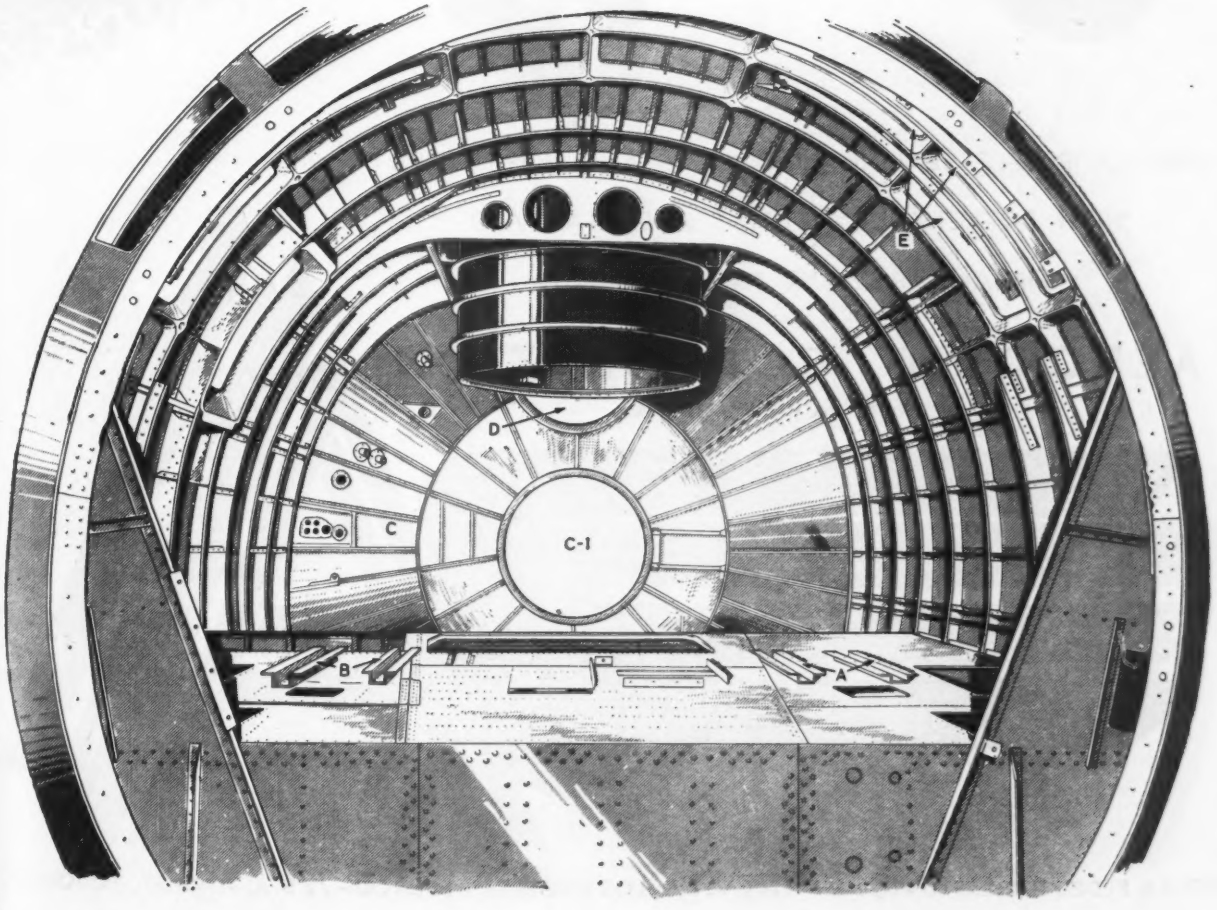
Curves are for Vickers Aircraft Variable Volume Piston Type Pumps Model AA-20 Series at 2400 rpm using approved AN aircraft type hydraulic fluid.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 192



Exterior view of forward part of Boeing B-29 Superfortress, showing method of providing extremely wide range of visibility for pilot, co-pilot, and bombardier. "Cap" of transparent plastic fits onto nose at extreme left. Fuselage here is of conventional bulkhead, stringer, and stressed skin construction.

Interior view, looking aft, in cabin control section of B-29. Foundations for pilot's and co-pilot's seats are at A and B, respectively. Concave bulkhead C (to which center portion C-1 is still to be added) separates this section from unpressurized bomb bays. Bottom part of tunnel through which crew members may crawl from one pressurized section of craft to another over bomb bays is shown at D. Some of pilot's windows can be seen at E.



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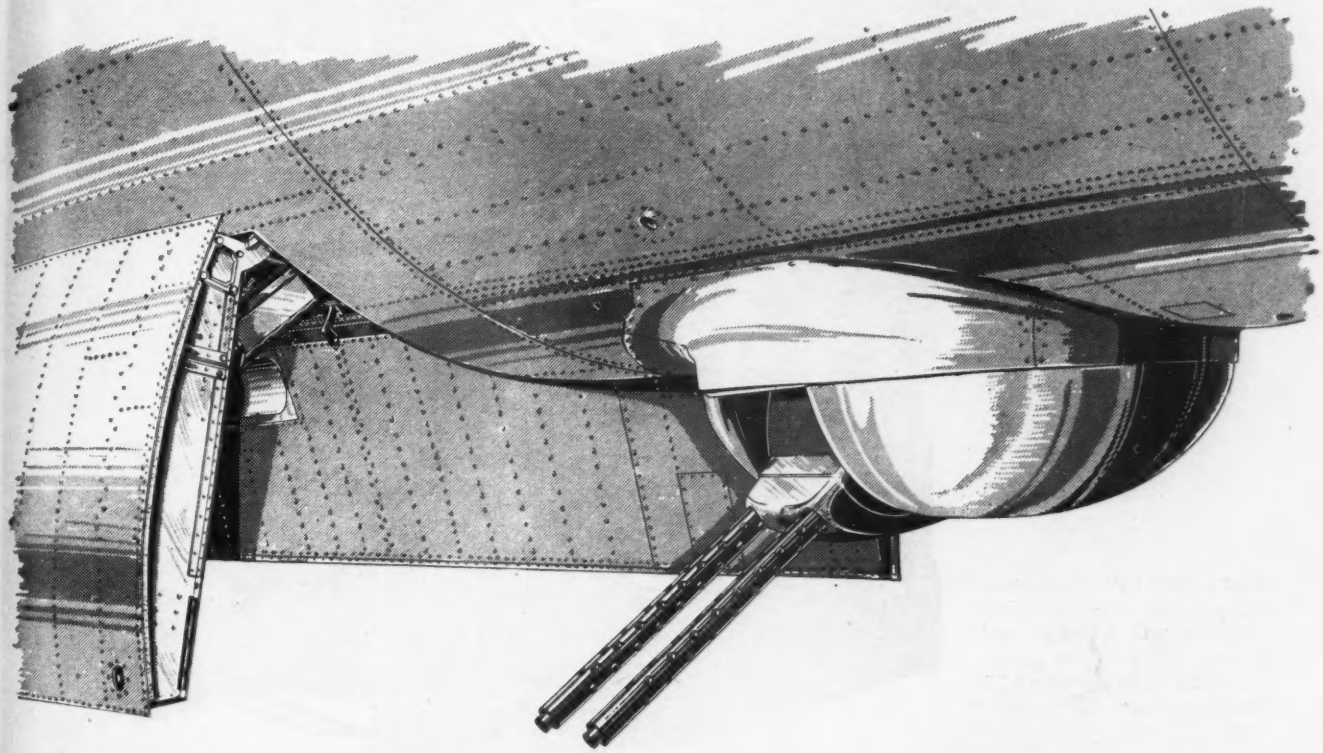
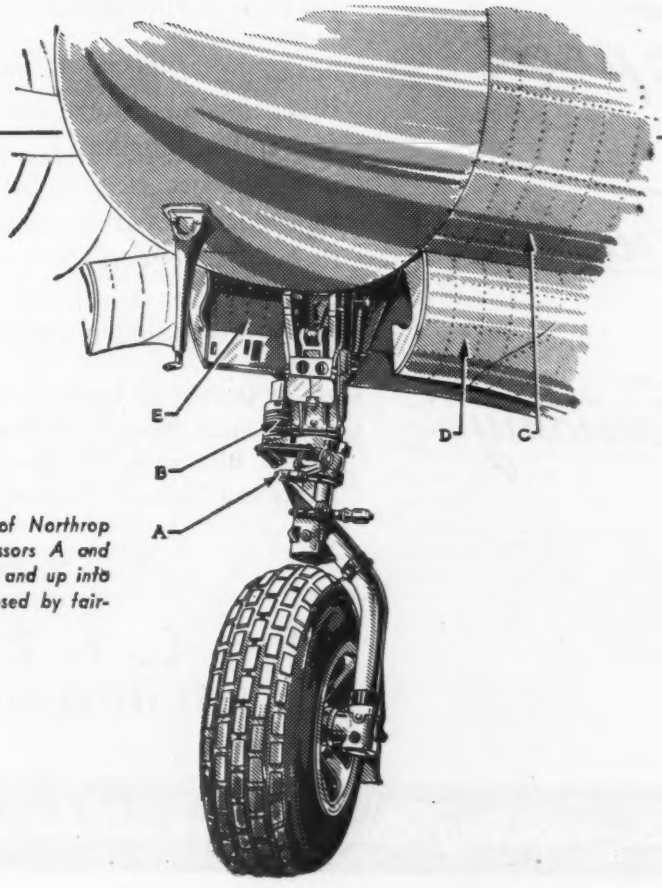


Remote-controlled fore-lower twin-50-cal. machine gun turret of Boeing B-29 Superfortress is located just ahead of forward bomb bay. Wide field of fire of turret is indicated by position of guns, and smooth fairing is shown. Built-up structure of bomb bay doors, as well as actuating lever on right door, can also be seen.



Nose wheel of tricycle landing gear of Northrop P-61 Black Widow, showing torque scissors A and shimmy damper B. Wheel retracts back and up into fuselage C, with the aperture being closed by fairing doors D and E.

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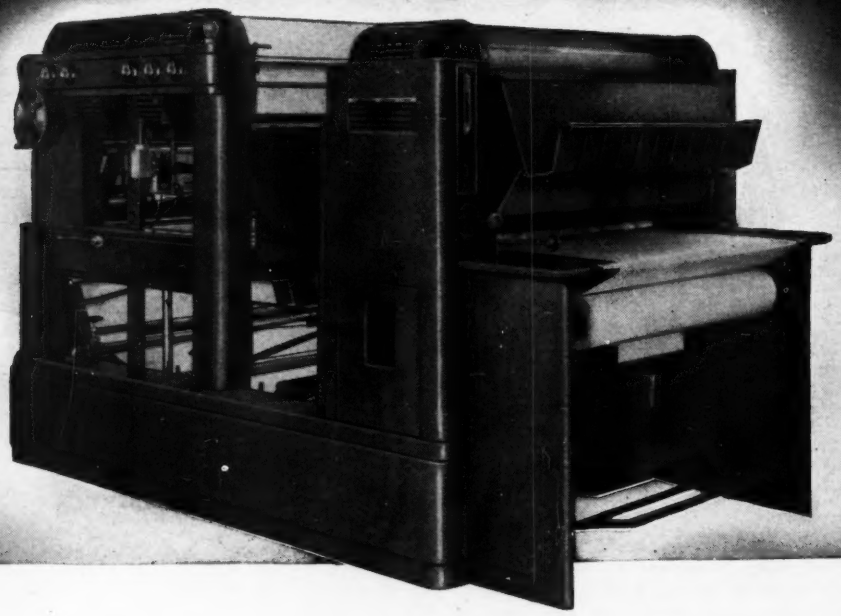

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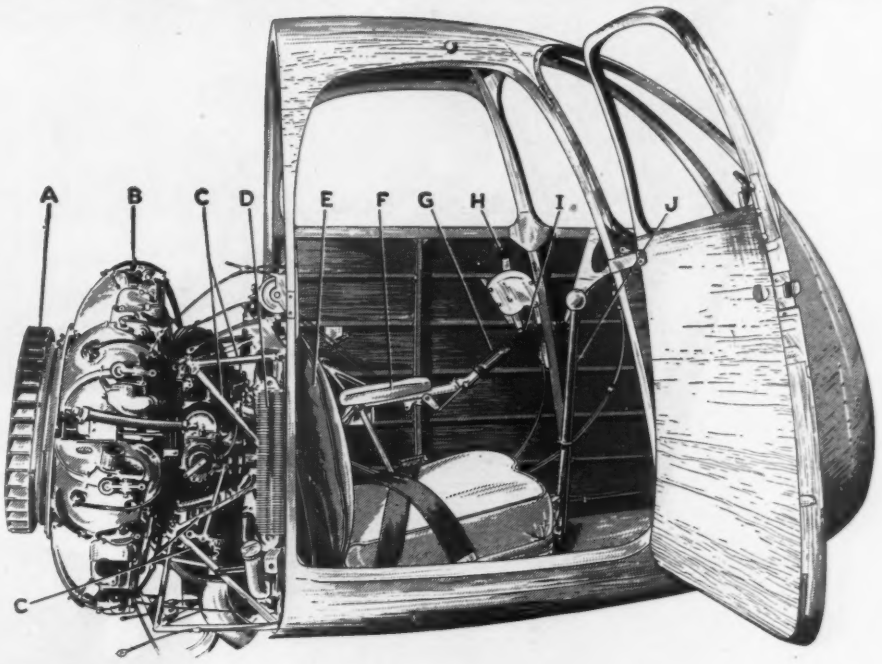
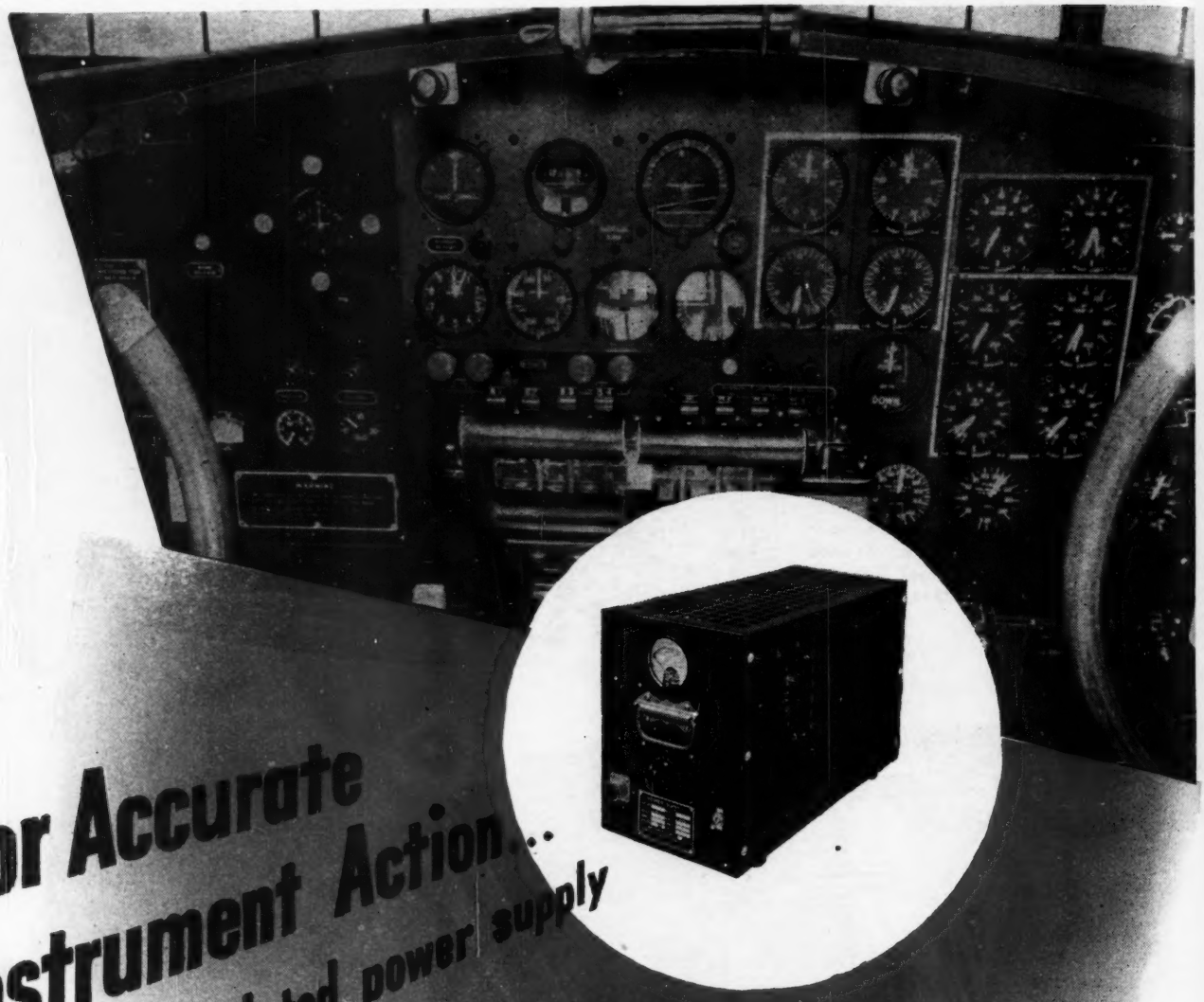


Pilot's cabin of Landgraf helicopter, showing installation of suction cooling fan A built-in to modified 85-hp. Pobjoy engine B, mounted in pusher position through engine mount C attached to firewall between oil radiators D, just behind pilot's seat E. Pitch control lever F has elbow rest pad aft of handle-bar grip for added leverage and additional feel. Both up and down and twisting motion are imparted to grip. Throttle and spark setting levers H and I are set just ahead of pitch control lever on left side of cabin, and control stick is shown at J. Semi-monocoque cabin is of wood frame covered with 3-ply Oregon pine skin. (Also see Aviation for Oct. 1944, page 186.)

Hull truss members of Boeing 314 Clipper are made up of square tubular vertical and diagonal members, as shown at A, and U-shaped top and bottom members, as at B and C. Keel is attached at D, and hull bottom stringers, with angle plates for attaching to truss, are at E. Bottom of cabin deck is at F.



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SHEET NUMBER D-25
CLASSIFICATION . . . . . Materials
SUBCLASSIFICATION . . . . . Stainless Sheet Steel

TEMPER of cold rolled stainless steel is the same as that of sheet brass, aluminum, and copper—*annealed, quarter hard, half hard, three-quarter hard* and *hard*, depending upon amount of working. Principal requirements under AN-QQ-S-772, in percentages, are: C, .12, .15 max. for .050 in. and thinner; Mn, .2 to 2.5; P, .04 max.; S, .04 max.; Cr, 17 min.; Ni, 6.5 min.; Si, .2 to 1.5; Cu, .5 max.; Ti or Cb or other stabilizing element at option of producer. About 17.5 percent Cr and 7.25 percent Ni is widely used, giving high ductility in proportion to tensile strength. The following data obtained from samples from Armco commercial shipments are more indicative of working material than laboratory specimens would be

Estimated Weights Of Stainless Steel Sheets

Chromium nickel stainless steel 42.0 lb. per sq. ft. per inch thick

Thickness	Gage	Decimal thickness, in.	Wt. per sq. ft., lb.
.161 to .176	8	.171875	7.2187
.146 to .160	9	.15625	6.5625
.131 to .145	10	.140625	5.9062
.115 to .130	11	.125	5.25
.099 to .114	12	.109375	4.5937
.084 to .098	13	.09375	3.9375
.073 to .083	14	.078125	3.2812
.066 to .072	15	.0703125	2.9531
.059 to .065	16	.0625	2.625
.053 to .058	17	.05625	2.3625
.047 to .052	18	.05	2.1
.041 to .046	19	.04375	1.8375
.036 to .040	20	.0375	1.575
.033 to .035	21	.034375	1.4437
.030 to .032	22	.03125	1.3125
.027 to .029	23	.028125	1.1813
.024 to .026	24	.025	1.05
.0199 to .023	25	.021875	.9187
.0178 to .0198	26	.01875	.7875
.0161 to .0177	27	.0171875	.7218
.0146 to .016	28	.015625	.6562
.0131 to .0145	29	.0140625	.5906
.0115 to .013	30	.0125	.525
.0105 to .0114	31	.0109375	.4594
.0095 to .0104	32	.01015625	.4265

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The simplified graph above shows the viscosity grade and temperature slope of Type 200 Fluids compared with hydraulic oils over a temperature range of –30°F. to 210°F. Note the flat slope of the DC Fluid. This illustrates a characteristic that has awakened keen interest. Here are fluids that *stay fluid,* even at temperatures far below zero. Such remarkable properties indicate that these new inert liquids are ideal for many precision instrument damping applications.

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Dow Corning

SHEET NUMBER . . . . . D-25 (cont'd)
CLASSIFICATION . . . . . Materials
SUBCLASSIFICATION . . . . . Stainless Sheet Steel

Data given in this table are conservative values based on tests of samples from numerous commercial shipments of Armco high tensile stainless steel. Strength values given are therefore minimums upon which working stresses can safely be based by the designer. In majority of shipments, strength values will be considerably higher than those indicated here.

PROPERTY	TREATMENT	TEMPER			
		¼	½	¾	F
Ultimate Strength 10^3 psi.		125	150	175	185
Longitudinal tension	Cold rolled	133	162	183	187
	Stress relieved	133	159	178	183
Transverse tension	Cold rolled	135	164	185	189
	Stress relieved	135	162	182	185
Longitudinal compression (at buckling)	Cold rolled	95	134	163	168
	Stress relieved	95	138	169	175
Transverse compression (at buckling)	Cold rolled	95	150	190	198
	Stress relieved	95	150	190	198
Yield Strength 10^3 psi.		75	110	135	140
Longitudinal tension	Cold rolled	75	117	147	153
	Stress relieved	75	123	157	164
Transverse tension	Cold rolled	75	110	135	140
	Stress relieved	75	121	153	160
Longitudinal compression	Cold rolled	62	83	99	102
	Stress relieved	66	104	132	137
Transverse compression	Cold rolled	75	123	156	163
	Stress relieved	75	127	165	173
Proportional Limit 10^3 psi.					
Longitudinal tension	Cold rolled	35	49	59	61
	Stress relieved	44	65	80	84
Transverse tension	Cold rolled	40	63	80	84
	Stress relieved	38	52	63	66
Longitudinal compression	Cold rolled	27	31	34	35
	Stress relieved	44	59	70	72
Transverse compression	Cold rolled	42	60	73	75
	Stress relieved	40	72	95	100
Initial Modulus of Elasticity 10^6 psi.					
Longitudinal tension	Cold rolled	27.0	27.5	28.0	28.0
	Stress relieved	28.0	28.0	28.0	28.0
Transverse tension	Cold rolled	28.5	28.5	28.5	28.5
	Stress relieved	28.5	29.0	29.0	29.0
Longitudinal compression	Cold rolled	27.0	28.0	28.0	28.0
	Stress relieved	28.0	28.0	28.5	28.5
Transverse compression	Cold rolled	27.0	28.5	29.0	29.0
	Stress relieved	27.5	29.0	30.0	30.0
Per Cent Elongation* **					
(0.016 to 0.030 in. thick)		25	18	12	9
Longitudinal tension	Cold rolled	46	37	31	29
	Stress relieved	52	39	29	27
Transverse tension	Cold rolled	38	30	25	23
	Stress relieved	58	36	20	17

***Rate of strain—0.2 in. per in. per min.

Courtesy, American Rolling Mills Co.

Review of Patents

By **A. HARRY CROWELL**, *Registered Patent Lawyer*

FOLLOWING are digests of some of the more interesting recent patents on aviation developments granted by the U. S. Patent Office. Mr. Crowell will gladly furnish readers with free information on approximate cost and procedure in applying for patents and trademark registration. Address inquiries to him, care AVIATION, 330 W. 42nd St., New York City (18). Printed copies of any of patents listed are obtainable at a cost of 10c each, directly from U. S. Patent Office, Washington.

Chute to Lower Plane in emergency calls for employment of rapidly opening pilot chute to quickly activate main chute. Invention is also applicable to personal pack-type chute.—2,352,721, filed May 15, 1941, patented July 4, 1944, P. Krahel.

Aircraft Inclination Indicator employs primary dial with vertical slot for a secondary dial which has one pointer to show inclination in bank and another pointer coacting with first dial to show inclination in ascent or descent.—2,352,758, filed July 13, 1943, patented July 4, 1944, H. F. Bauknecht.

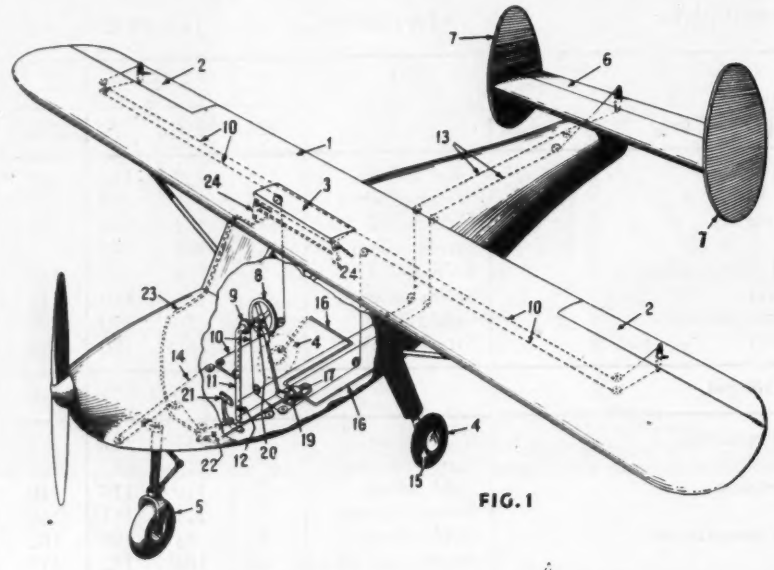


FIG. 1

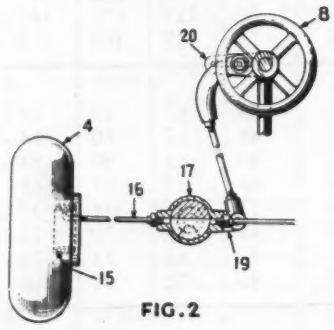


FIG. 2

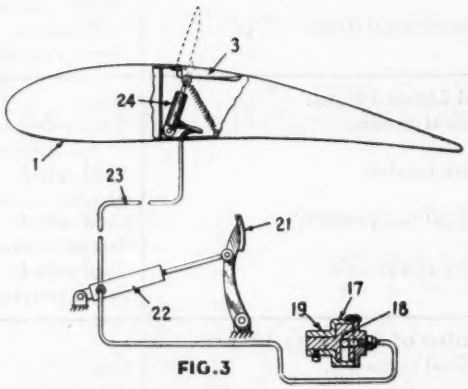


FIG. 3

New Flight and Ground Control means for aircraft is held to be particularly useful in connection with plane of two-control type normally directed by manual operation of ailerons and elevator only, without use of pilot's feet for directional control. Fig. 1 shows wing (1), aileron (2), spoiler (3), main landing gear (4), steerable nose wheel (5), elevator (6), and vertical tail units (7). Deperdussin wheel (8) revolves cable drum (9) to operate aileron cable (10). Control column (11) pivots about lateral axis (12) to move fore-and-aft, operating elevator cables (13). Wheel (8) also operates ground-steering cable (14) whose ends are attached to aileron cables for simultaneous operation so that nose wheel (5) steers to right when wheel (8) is turned to right, and vice versa. Main landing wheel (4) has hydraulic brakes (15) connected by conduits (16) to housing (17). Referring to detailed Fig. 2, latter housing contains rotatable valve (18), seen in neutral position. When valve (18) is rotated from neutral by arm (19) connected to arm (20) on wheel (8), fluid flow to one of brakes is cut off, applying hydraulic pressure to left wheel if turn is to left, and vice versa. Fig. 3 shows how brake pressure is supplied by action of brake pedal (21) on brake cylinder (22) which also supplies pressure through line (23) to spoiler cylinder (24). Initial partial depression of foot pedal elevates spoiler (to desired position up to maximum shown by dotted lines) for glide-path control as in approach to landing area. Continued depression of pedal actuates brakes. This is Patent No. 2,355,026, filed Oct. 9, 1943, patented Aug. 1, 1944, O. C. Koppen, assignor to General Aircraft Corp.

Airplane Testing Apparatus for use in wind tunnel is designed to simulate accurate flight conditions, permit variation in angle of attack and variation in direction of flight with respect to airstream, and indicate individual component forces contributing to resultant movement of craft. Provided is system of weighing scales and levers to register both positive and negative forces and resolving resultant forces into attendant various components.—2,353,033, filed Sept. 6, 1941, patented July 4, 1944, H. O. Hem, assignor to Toledo Scale Co.

Aircraft Heater adapted to function under relatively high altitude conditions calls for a simplified automatic control system. It utilizes differential pressure created by supercharger to cause flow to heater of combustible mixture and flow therefrom of products of combustion.—2,353,112, filed Dec. 12, 1940, patented July 4, 1944, S. S. La Sha and F. M. Salisbury, assignors to the Bell Aircraft Corp.

Airfoil Invention relating to tailless plane supplies longitudinal-control means consisting of tabbed flaps along portion of trailing edge, to eliminate excessive vertical forces.—2,354,942, filed May 1, 1937, patented July 18, 1944, M. M. Munk.

Hollow Steel Propeller Blade fabrication method utilizes straight tubular blank which is first tapered at ends to produce shape which, when flattened, results in seamless edges at folds of desired profile.—2,354,198, filed July 12, 1941, patented July 25, 1944, L. B. Chubb, assignor (by mesne assignments) to The Aviation Corp.

Inboard End Attaching Means for aircraft wings is particularly applicable to stringer-reinforced metallic stressed skins and is permanently connected thereto by spot welding so that there is efficient transfer of wing stresses to adjacent structure.—2,354,236, filed Mar. 6, 1943, patented July 25, 1944, M. Watter and H. J. Scammell, assignors to Edward G. Budd Mfg. Co.

Method for Protection against attacking aircraft is in direct contrast to area blackout procedure. Invention is intended to utilize unique light pattern to brilliantly illuminate air space above area, thus creating dazzling glare which will blind and confuse pilots of hostile craft, thereby effectively concealing objective.—2,354,665, filed June 22, 1942, patented Aug. 1, 1944, J. H. Church and E. W. Ruestow.

(*Turn to page* 306)

Book Reviews

DIAMOND TOOLS, by Paul Grodzinski. Anton Smit & Co., Inc., N. Y. C., 378 pages, illustrations. $4.50.

This detailed survey deals with the construction and the application of diamond tools by many industries, including, in particular, the metal working industry. Hence, the book is of interest to aircraft and component manufacturers. Data on the properties of diamonds are included. Facts relating to machining of metals, cutting and truing of grinding wheels, and applications in hardness are among the subjects covered.

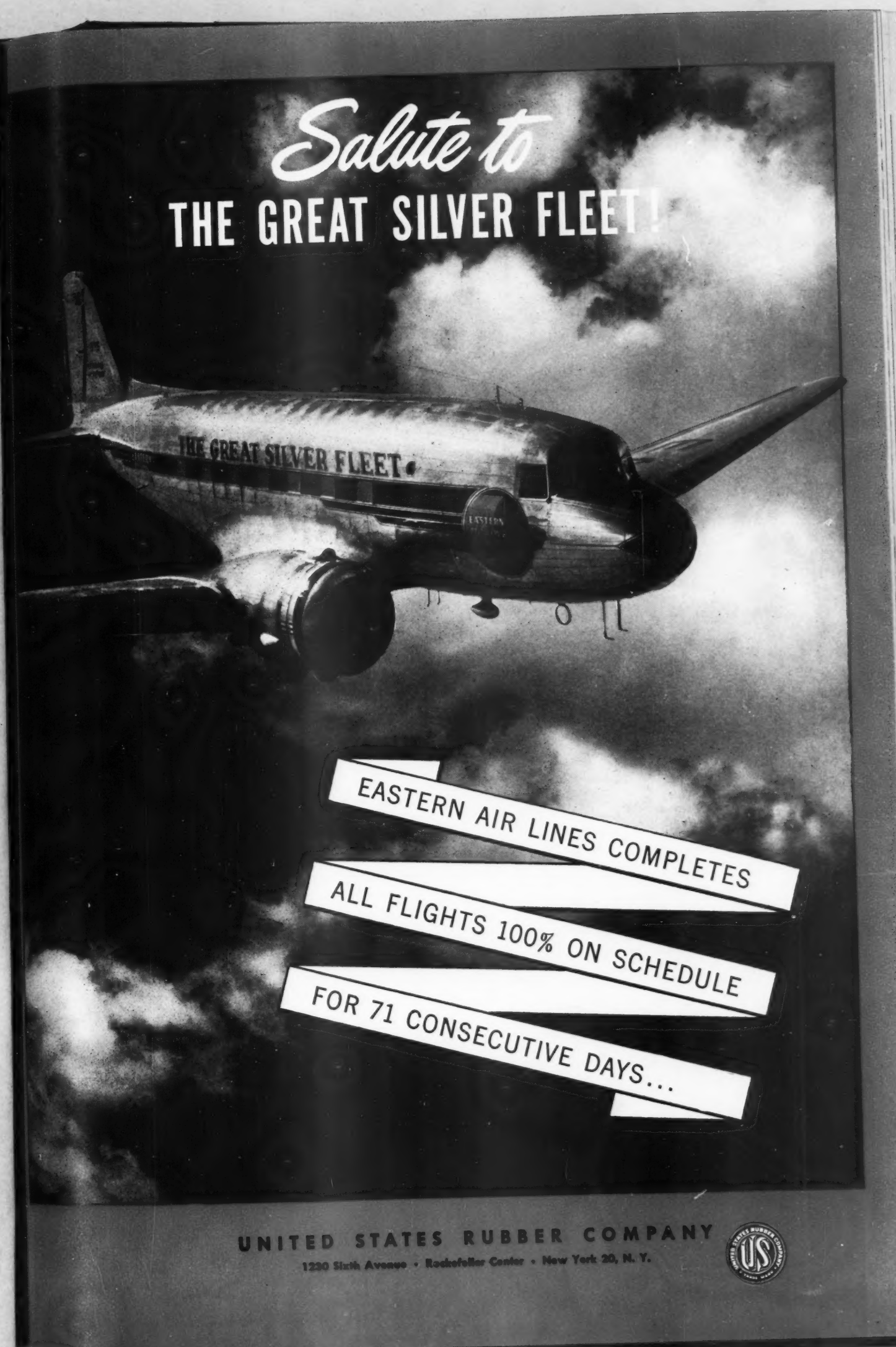
BOMBERS ACROSS, by Capt. Edgar J. Wynn. E. P. Dutton & Co., N. Y. C. $2.50.

Called the initial book to be written about the Air Transport Command, this volume's story is told with authority. Those who have read only short articles regarding this all-important phase of the war-supplies service will find here an interesting and comprehensive coverage of the subject.

MATERIALS HANDLING, by Lt. Comdr. H. E. Stocker, USNR. Prentice-Hall, Inc., N. Y. C., 309 pages, photos, diagrams, charts. $5.00.

Comprenensive handbook designed to show means of eliminating bottlenecks in the conveying and handling of materials used in industrial manufacturing. Problems are attacked through the

(*Turn to page* 306)



UNITED STATES RUBBER COMPANY

1230 Sixth Avenue · Rockefeller Center · New York 20, N. Y.

Eastern writes a new page in Airline History!

New York Times Editorial—August 4, 1944

AIRLINE PERFORMANCE

Spectacular accomplishments by bombers and fighters have brought us some realization of the startlingly swift advances which have been made under the stimulus of war in the range, speed and reliability of aircraft. Combat reports have tended to overshadow, however, the correlative advances which are being made in commercial air transport. The airlines, not only in their function as aids and operators for the armed services in a great network of global flying, but in their domestic operation, have taken great forward strides during the war years. With reduced fleets and personnel, they still have been able to set new marks in passengers, mail and goods carried, and in the performance of schedules. Eastern Airlines, for example, has just established a record not heretofore equaled in commercial air transport history, flying all its schedules with 100 per cent performance for the two consecutive months of June and July. During these months the line's "silver fleet" flew 43,000,000 revenue passenger miles in domestic operations alone, while its cargo liners averaged about 20,000,000-pound miles a day.

This performance and that of the other air carriers, which are showing load factors and percentage of airplane use per day which would have been deemed incredible only a few years ago, indicate the expanded air service for which we may look in the days of peace.

TO TIE OR NOT TO TIE

Never was there a day when it was so vitally important to the nation that high-priority air travel move swiftly to its destination . . . that increased loads of air cargo arrive in plenty and on time.

The achievement of Eastern Air Lines in completing all flights 100% on schedule for 71 consecutive days in the face of capacity loads and with daily flying time of every airplane almost doubled over prewar days is a record that in the words of the New York Times editorial of August 4, 1944, "not heretofore equalled in commercial air transport history."

With a fleet reduced 50%, Eastern has equalled and even exceeded prewar records of passengers and cargoes delivered. With each Silverliner in the air an average of 14 hours and 7 minutes every day, Eastern Air Lines maintenance men are doing a greater, more important job than ever.

As a part of Eastern's regular maintenance plan, every part of the plane is checked, double-checked and triple-checked from propeller to tail wheel tire. The results of this program have made possible a great page in airline history, the forerunner of even greater pages ahead.

1230 SIXTH AVENUE **UNITED STATES**

AND THEY DID THIS JOB BY

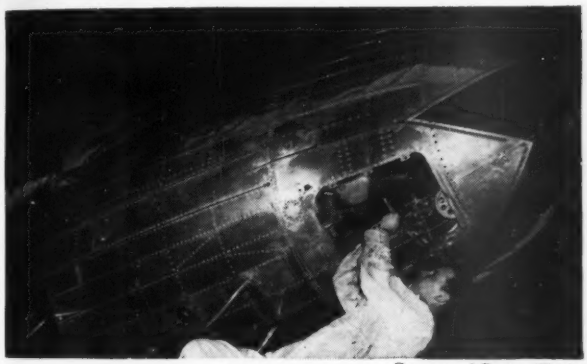
Check, Double Check...and Triple Check

Courtesy of Curtiss-Wright

Station Control Board for Maintenance . . . Upon this board is recorded every maintenance service that must be performed by the ground crew before a plane can be cleared for its next flight.

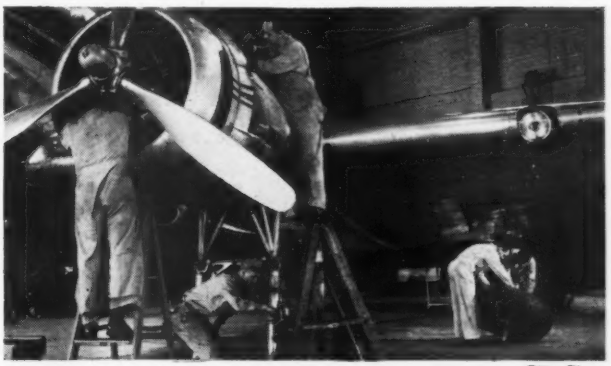
Giles Photo

Station Check . . . At the end of every trip, Eastern Air Lines ground crews check engines, engine and flying instruments, radio equipment, controls, propellers, tires and brakes.



Courtesy of Curtiss-Wright

Terminal Check . . . The basic station check is repeated plus inspection of electrical, ventilation and air conditioning systems, gasoline and oil strainers and valves. Plane and upholstery are cleaned.

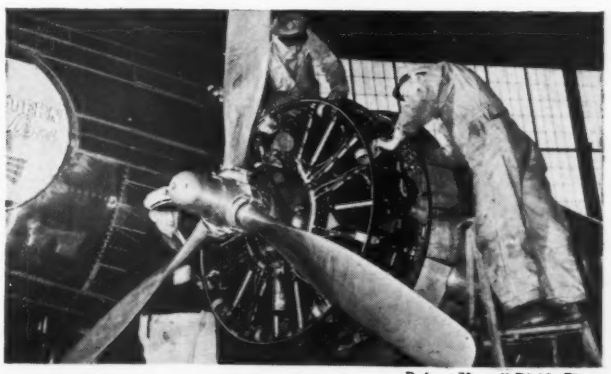


Giles Photo

Base Check . . . This is a complete check-up of the entire plane. Engines, propellers, radio controls, landing gear are inspected with special attention to condition of wheels, brakes and tires.

Giles Photo

650 Hour Check . . . Wheel assemblies are now removed for overhaul. This includes demounting the tire for complete inspection of both tire and tube. Special attention is also given bearings and brakes.



Robert Yarnall Richie Photo

6,500 Hour Overhaul . . . Propellers, engines, electric and radio equipment, lubricating systems, wheels, brakes, tires and all accessories are disassembled and carefully checked before return to service.

RUBBER COMPANY ROCKEFELLER CENTER · NEW YORK 20, N. Y.

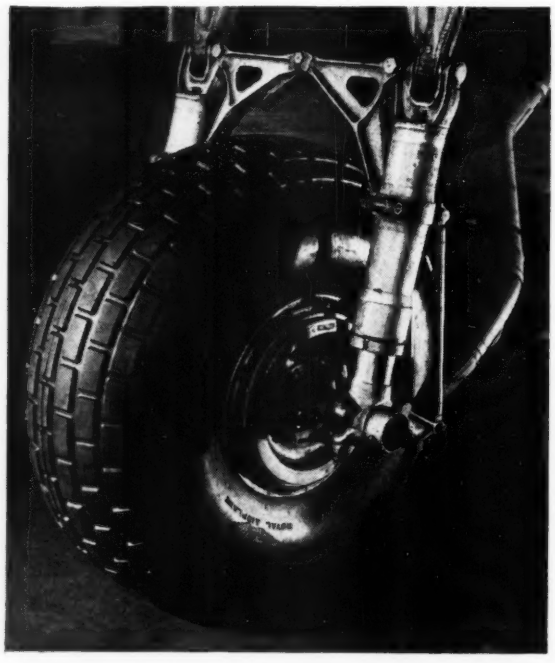
SAFETY FIRST, LAST AND ALWAYS

IS EASTERN AIR LINES' CREED

National Safety Council
Incorporated
Founded 1912
"A National Organization Devoted to Securing Increased Safety to Human Life"
Certificate of Special Commendation
Awarded to
Eastern Air Lines
in recognition of its outstanding record in
Safe Air Transportation
Never having had a passenger fatality during its entire operating history: 1930-1936 with an accumulation of 141,194,894 Passenger Miles
This, according to the U.S. Department of Commerce records is the best Air Transport accomplishment to date.
New York, April 19, 1937.
NATIONAL SAFETY COUNCIL
INCORPORATED
Founded 1912
"A National Organization Devoted to Securing Increased Safety to Human Life"
AVIATION SAFETY AWARD
TO
EASTERN AIR LINES, INC.
in recognition of its contribution to Safe Air Transportation having operated as of December 31, 1943
635,000,245 Passenger Miles
without a passenger or crew fatality

FIRST SAFETY AWARD—In 1937 the National Safety Council instituted the Aviation Safety Award for Safe Air Transportation. On its record of no passenger fatalities in its entire operating history (1930-1936) Eastern Air Lines won this award. The certificate states, "This, according to U. S. Department of Commerce records is the best Air Transportation Accomplishment to date."

LATEST SAFETY AWARD—Other awards followed and again in 1944 Eastern Air Lines won the National Safety Council Award for commercial air lines operating 100,000,000 passenger miles or more annually. Their record for safe air transportation for the period ending December 31, 1943 totaled 635,000,245 passenger miles without a passenger or crew fatality.



U. S. ROYALS

ARE SAFETY-TESTED, TOO

By test on Eastern Silverliners, in service on landing fields and carrier decks wherever airplanes fly, U. S. Royal Airplane tires have proved their stamina. They are contributing their part in making landings and take-offs safer under heavier loads and tougher operating schedules.

To give the extra strength, extra safety needed to do this wartime job, "U. S." pioneered lighter, stronger rayon and nylon cord constructions now used throughout our Armed Forces. On the air routes of the world, on airliners, bombers, fighters and giant transports, U. S. Royal Airplane tires are setting new safety records day by day.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E.W.T. Carl Van Doren and a guest star present an interlude of historical significance.

SERVING THROUGH SCIENCE TO SPEED THE VICTORY

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20, NEW YORK

The AVIATION NEWS

BLAINE STUBBLEFIELD, Washington — HERB POWELL, New York

Need Better Personal-Plane Pricing, Safety, Utility to Realize Big Market—T. P. Wright

. . . Favors federal-local cooperation in program for fields . . . ACCA distributes 20,000 airpark booklets . . . Light plane "go-ahead" . . . Do surplus-auctions queer plane market? . . . "Modify personal-flying rules," says Chamber . . . Award Sikorsky, Gregory AHS fellowships . . . Flight-area bans being lifted.

To attain a total personal plane ownership of 400,000, and a delivery rate of 175,000 a year, within 5 to 10 yr. after the war, the industry will have to create designs having better combinations of price, safety, and utility than they have now, in the opinion of T. P. Wright, newly-appointed administrator of Civil Aeronautics.

In a conversation with AVIATION's Washington editor, Mr. Wright emphasized his judgment that the industry has done an excellent job. But, he said, there are many problems. Some producers have achieved attractive prices, some offer a high degree of safety, and others have favorable utility—however, none so far produced has all the features necessary to justify the market hoped for.

The helicopter is moving toward the desired characteristics, Mr. Wright stated, adding that producers of fixed wing types can meet non-professional requirements if they will recognize the problem as a difficult one and set out to beat it.

Opinions expressed by Mr. Wright, former vice-president and director of engineering with Curtiss-Wright, and responsible head of aircraft scheduling up to the peak of production in this war, are regarded as indicative of CAA policy in the coming transition of civil aviation back to a peace basis.

The Administrator stated that an annual personal plane output rate of 175,000 would constitute a good-sized industry. At $2,000 apiece, sales would total $350,000,000 a year. Comparing the personal plane market with that of air transport, Mr. Wright pointed out that even if sales in the latter category should reach 500 per year, at $200,000 per unit, the total would be only $100,000,000.

Favors Federal-Local Program for Fields

One important step that must be taken toward greater utility and safety of personal aircraft is not in design at all but in expansion of the system of airports, airparks, and airstops, so that flyers can land near destinations. Mr. Wright favors early action by Congress, providing federal money to be matched with local funds, nearly all for private aviation. Rep. Jennings Randolph has introduced such a bill, HR 5042, which would authorize $100,000,000 annually for 10 yr. to build fields.

Meanwhile, the Civil Aeronautics Administration, after a year of study, is recommending to Congress a similar program, which may be incorporated with the Randolph proposal.

Public and industry opinion is almost unanimous in favor of an airport program, concentrating on small airfields. The Personal Aircraft Council of the Aeronautical Chamber of Commerce has sent out more than 20,000 booklets to guide town, county, and state authorities in location, design, and construction of in-town airparks.

Both the council and CAA express the hope that local governments will not wait for federal aid but will go ahead on their own and be ready for peacetime air activity. All concerned recognize the difficulty of finding close-in land and of meeting complaints against airplane noise and caring for necessary zoning, etc.

Light Plane "Go-Ahead"

By the time you read this, several light plane manufacturers probably will have been authorized to commence production for civilians. WPB aircraft officials believe such a step is desirable to make planes available to fixed base and taxi operations which will employ returning military air crewmen. WPB Order L-48 provides that war manufacturers may apply for authority to shift to civilian production.

When this was written, WPB was surprised that only a half dozen had applied. It was believed, however, that all were making preparations and had overlooked L-48. At present, manufacturers shifting to civilian work are required to show substantial orders for essential products. It is believed that this provision is being repealed, but even if it is not, probably the light plane people can show the necessary orders.

Do Surplus-Auctions Queer Market?

Whether or not surplus light planes being sold at auction curtail the market for new deliveries is a matter of disagreement among manufacturers. Some say that sale of used military types will stimulate new sales, while others insist that unsatisfactory experience with purchases, and low trade-in value, will hurt the market. Whatever the truth may be, surplus sales may not be as large as many

FIRST PHOTO OF INVADER

Described by War Department as newest and fastest all-purpose bomber, this is Douglas A-26 Invader, specifically designed for either low or medium altitude operations against enemy ground and naval forces and installations. Combined in craft are heavy firepower and bomb capacity plus great speed. Power is supplied by twin Pratt & Whitney 2,000-hp. R-2800 Double-Wasp engines. NACA low-drag (laminar flow) airfoil section is employed, and double-slotted flap is a feature. Design for maintenance simplification stresses accessibility to parts, and nose takes special-mission equipment on production line, thus saving trip to modification center.

Coming Up

November 9-10: Fall Meeting, Institute of Aeronautical Sciences, Dayton.

November 13-14: National Association of State Aviation Officials, Annual Meeting, Skirvin Tower Hotel, Oklahoma City.

November 13-14: Annual Fall Convention of Society of the Plastics Industry, Waldorf-Astoria Hotel, New York.

November 14: National Aeronautic Association, Board of Directors Meeting, Skirvin Tower Hotel, Oklahoma City.

November 15-18: Second Annual Clinic of Domestic Aviation Planning, Oklahoma City.

December 4-6: Society of Automotive Engineers National Air Cargo Meeting, Hotel Knickerbocker, Chicago.

December 5-7: Aviation Distributors & Manufacturers Association, Second Annual Meeting, Hotel Jefferson, St. Louis.

December 6-7: National Aviation Trades Association, Annual Convention, Hotel Jefferson, St. Louis, Mo.

December 17: Wright Brothers Lecture, Institute of Aeronautical Sciences, Washington.

January 8-12: Society of Automotive Engineers Annual Meeting & Engineering Display, Book-Cadillac Hotel, Detroit.

January 30-February 1: Thirteenth Annual Meeting, Institute of Aeronautical Sciences, New York.

April (date to be announced): Spring Meeting, Institute of Aeronautical Sciences, Detroit.

observers have been figuring.

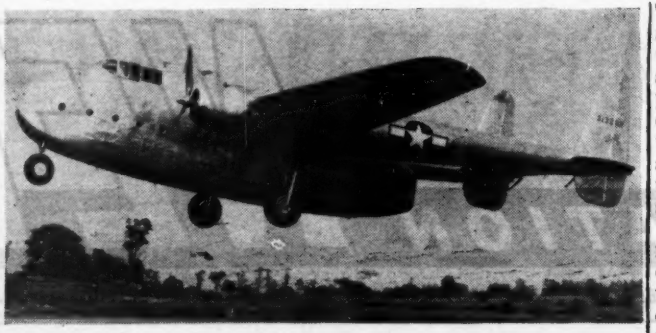
Nearly all of the 5,400 WTS trainers have been sold. Army light liaison planes so far declared surplus total not more than 2,000. It will be months before many more can be released. Probably the majority of those overseas will not be worth shipping home. Most of the heavier basic trainers will not be suitable for private operation, though crop dusters, some schools, and some foreign governments may take large numbers of them. For a while the hungry market will absorb every item available.

"Modify Personal-Flying Rules," Says Chamber

Modification of regulations on personal flying is recommended by the Personal Aircraft Council, Aeronautical Chamber of Commerce, in a statement to William A. M. Burden, Assistant Secretary of Commerce; L. Welch Pogue, chairman of CAB; Theodore P. Wright, administrator of CAA; and Senate and House aviation committees.

Council Chairman J. T. Geuting, Jr., urges a reduction of "must" regulations to the "enforceable minimum," the substitution of "should" suggestions, and a "safety in flight" educational campaign. Any citizen should have the right to secure a pilot's certificate with ease comparable to getting a driver's license, the Committee says.

The council asks that rules governing aircraft type certification be re-drafted, giving manufacturers more responsibility and the government less. It is remarked that the automobile industry has achieved world leadership through industry initiative, unhampered by government regulation.



C-82 IS FLYING BOXCAR

Capacious Fairchild C-82 Packet is 50,000-lb.-class 3,500-mi.-range aircraft designed to carry tanks, supplies, and troops. And mounting two P. & W. 18-cyl. R-2800-22 engines, each affording 2,100 hp. at takeoff, craft is built to operate into and out of small fields. Squarish fuselage features vertical walls and unobstructed space for its entire length, and floor of the compartment is parallel to ground for ease in loading through hinged aft-section of body, which opens laterally to full width and height. Craft is of metal construction, and span is 106 ft. While present production is for AAF, peacetime passenger and cargo use of plane is foreseen. It is estimated that airline model would carry 76 patrons by day and 30 by night in berths; and seats could be removed in an hour to make ship a freighter.

'COPTER GOES COMMERCIAL

Postwar potential of rotor craft is typified in this Aeronautical Products helicopter, Model 1-A, assembled and test-hopped by Wiggins Airways, Norwood, Mass., for it recently flew in first commercial flight, delivering packages for Wm. Filene's, Boston. Shown are: H. E. Shaw, executive director of Wiggins, C. C. Layman, v.-p. of AP, and J. Garside, Wiggins' president. Designed by AP Pres. Alfred Jackson, craft has Franklin 4-cyl. horizontally opposed engine, developing about 130 hp. Large toothed-wheel protruding just forward of landing gear is driven off crankshaft and drives under-floor shaft to rotor mast. Three-bladed main rotor has steel tubular spar built up with ribs and fabric. Power for craft's anti-torque rotor is taken off main rotor mast through gearing at fixed rpm. ratio of 2:1. Front nose grill takes in cooling air in forward flight, aiding blower fan fed through top grill. Recent exhibition of this 'copter to New Yorkers visiting at Bonwit Teller store was first step in nationwide tour arranged by Promotional Production Co., sales technicians.

Award Sikorsky, Gregory AHS Fellowships

First honorary fellowships in the American Helicopter Society were recently awarded to Igor Sikorsky and Col. H. Frank Gregory at the society's initial annual dinner in New York City, a gathering at which it was announced that membership exceeds the 200 mark. C. L. "Les" Morris, president, tendered the certificate to Mr. Sikorsky; Ralph P. Alex, AHS' first president, made the award to Col. Gregory.

Pointing out that helicopter engineering still has many difficult problems to solve, Pres. Morris declared that the industry needed sizable funds for research and development. He suggested a starting fund of $10,000,000, possible to be allocated to NACA, since the results would then be open to the entire industry, and he noted that "it seems reasonable that the basic, well-rounded research program funds should be granted by the government."

Accepting his award, Mr. Sikorsky declared that "no other engineering development has moved as fast as has the helicopter", and he said there was "no doubt about the 'great future' of the craft. America is leading in helicopter development," he declared, adding that the country "should, through research and development, maintain this leadership."

Civil Air-Fuel Rationing Now Under CAA

After a months-long battle between OPA, WPB, PAW (Petroleum Administrator for War), and CAA, the latter was given control of rationing 73-80 octane gasoline for nonscheduled aviation. OPA, as the government's rationing agency, didn't want to break precedent by letting gasoline out of its hands; CAA contended its special knowledge and field facilities were essential to equitable distribution, and won.

Effective Nov. 1, CAA safety inspectors began supervision of allotments to airport retailers, who apportion fuel to essential uses: Pilot training, transport of persons and cargo, and maintenance of aircraft airworthiness. None goes for barnstorming, sightseeing, or joy hopping.

Flight-Area Restrictions Now Being Lifted

Flight corridors leading out of a number of airports in formerly restricted areas have been approved by the Army. Accordingly, it is now possible for civilian pilots to fly out of defense areas in eight locations.

National Aeronautical Association gave the number of airports thus relieved as about 60, however the Army has not confirmed the total, it only named the approved corridors. These lanes are about 3-mi. wide and the boundaries specifically defined.

Permission to lift such restrictions is first obtained from Fighter Command headquarters, then CAA assigns channels out of the zone.

★ SPOT CHECKING ★

Stand of Airlines Committee for U. S. Air Policy, favoring "regulated competition" in international air transport, has now been presented in 27-page documentary brochure, "Worldwide Airlanes for United States Airlines, Competition vs. Monopoly."

Cost of Boeing B-29's is revealed by ATSC as being approximately $600,000 on current production models, contrasting with $3,392,396 outlay on initial ship.

New step toward simplifying private flying regulations is order easing certification of physically handicapped. Persons having physical defects need now only prove their ability to fly safely, though limitations may be placed on types and makes of craft, or compensating remodeling may be required.

United Nations' production of 100-octane gas exceeded combat and training requirements in October, for first time bringing accumulation of needed working stocks.

Two coast-to-coast flight records have been approved by Contest Board of NAA. Both made on Mar. 12 in P-51 Mustangs, they are: West-to-east with refueling (Kansas City), 6 hr. 31 min. 30 sec., by Col. C. A. Peterson, USAAF; and west-to-east nonstop, 6 hr. 39 min. 30 sec., Lt. Col. Jack Carter, USAAF. Previous transcontinental mark was 7 hr. 28 min. 25 sec. by Howard Hughes, Jan. 19, 1937, in Hughes' special monoplane.

Digest of authoritative predictions on postwar aviation is

MAMMOTH DIE-PRESSED FORGED ALUMINUM PISTON

by REVERE

Weight, 9⅞ lbs.; size, 6⅜" diameter x 5½"

THIS is really a large piston, used in high-power engines for the bigger bombers and freighters. It is made by the die-pressed forging method pioneered and perfected by Revere. Previously, any such shape would start as a casting. The Revere method produces a vastly improved product, having a close-grained, homogeneous structure of increased strength. Even the most intricate shapes can be made quickly, and so accurately as to require a minimum of machining. Revere forgings are also available in magnesium, copper and copper alloys.

The piston pictured is made from 18S alloy rod, designated as 18ST after heat treating. In the post-war period fewer pistons of this size will be required; instead, the chief demand will be for much smaller ones for plane, passenger car and truck use. When that time comes, remember the advantages of the Revere forging process. We shall be glad to cooperate with you *now* in planning for the future.

TECHNICAL ASSISTANCE: The Revere Technical Advisory Service is at your command in working with aluminum and magnesium alloys. Send for your complimentary copy of the *new* booklet "Revere Magnesium Alloys and the Light Metals Era." Also available: the 54-page manual, "Revere Copper and Copper Alloys—Technical Information for Product Designers." Write Revere Executive Offices.

REVERE

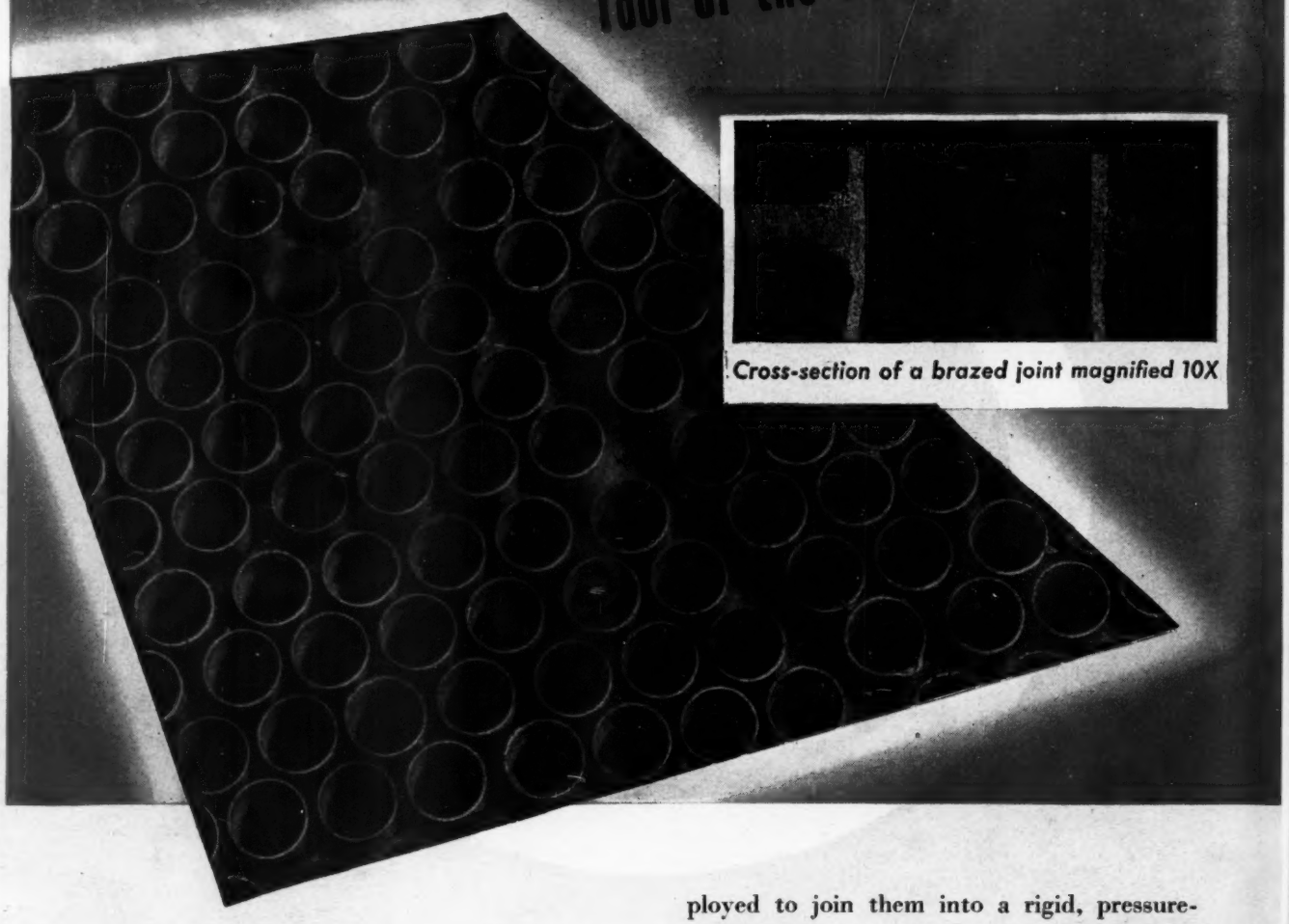
COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Ave., New York 17, N. Y.

Brazing—

Tool of the Honeycomb Makers



Cross-section of a brazed joint magnified 10X

Fabrication of lightweight aluminum cores for many types of heat exchangers—aircraft radiators, oil coolers, heaters—is accomplished by brazing. Aluminum alloys contribute strength and light weight, superior heat conductivity and resistance to corrosion. The brazing process provides speed and uniformity of production.

In the tubular-core section pictured above, thin-walled aluminum tubing and Alcoa sheet, perforated to receive the tubes, are assembled in a fixture which holds all parts firmly in place. Furnace-brazing is then employed to join them into a rigid, pressure-tight unit. Other fabricators may employ flux-bath brazing, hand welding and brazing, or combinations of all methods.

How the molten brazing alloy flows at the line of contact, forming a fillet which bonds all parts securely together, is seen in the above photomicrograph.

Alcoa will assist you in adapting the brazing process to your products, advising on initial and final cleaning methods, fluxes and brazing temperatures. For this help, write ALUMINUM COMPANY OF AMERICA, 2182 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA ALUMINUM

offered in "Aviation Predictions," 31-page booklet prepared by Aviation Research Associates, New York, for Simmonds Aerocessories, Inc. Private flying, air transport, and military are covered in handy collation of forecasts by aviation leaders.

AAF logged 20,100,000 military flying hours in continental U. S. during first six months of 1944, as compared with 13,400,000 hr. for same period in '43. Despite big increase, fatal accidents were reduced, with over-all accident rate dropping 29 percent in first five months.

Seven steps are called for by Harry Woodhead, Convair president, to aid aviation industry demobilization: 1. Adequate unemployment insurance, 2. transport of workers to new jobs or bona fide homes, 3. prompt contract termination, 4. advance notices of cutbacks, 5. earliest resumption of civil aircraft manufacture, 6. intelligent surplus-aircraft disposal, and 7. continuation of college air training program.

More than 40,000 Cyclone 18 engines are called for in next 15 mo. to power Boeing Superfortresses, states Col. J. M. Gillespie, deputy chief, Engineering & Procurement, ATSC.

A 2-yr. course in aviation operations management, established at request of the industry, has been inaugurated at Texas A. & M. College to train airport and fixed-base operations managers, reports Dr. Howard W. Barlow, acting dean of engineering.

Newly dedicated is $1,250,000 airfield at Deer Park, Wash. There are three paved runways, each 6,100-ft. long and 150-ft. wide, built to handle heaviest planes.

San Francisco Chamber of Commerce has formed an aviation department to coordinate activities of Bay Area Aviation Committee, managed by Kenneth R. MacDonald. Aim is to establish city as leading passenger and freight air terminal of West.

Meanwhile, super air terminal is planned by Oakland, Calif., Board of Port Commissioners, which has announced $10,000,000 will be spent at Oakland Municipal Airport for improvements exclusive of hangars and other structures.

New gyro lead-computing gunsight "brain", jointly adapted for mass production by Bendix and Eastman Kodak, is American version of British Mark II-D device (see photo, page 226, Oct. AVIATION). Navy aerial gunners are employing sight.

"London Star" reports air pickups by Allied planes of patriots behind German lines, source of story being a broadcast from Sweden. First, it is reported, parcel containing special harness is dropped by chute, then man wearing this rigging lies flat on ground, plane swoops low, harness is hooked onto tow rope, and man is hauled aboard. Remarking on feasibility, Pres. Halsey R. Bazley of All American Aviation, says, "We know it can be done."

Through minor changes by Martin company engineers, Plexiglas noses for B-26 Marauders now become tail enclosures for Navy Mars craft.

Lawrence Aeronautical Corp., Linden, N. J., announces adoption of new insurance benefit plan for its workers. With all costs assumed by company, approximately $5,000,000 in life insurance—ranging from $2,000 to $8,000 per employee—now covers 1,200 personnel.

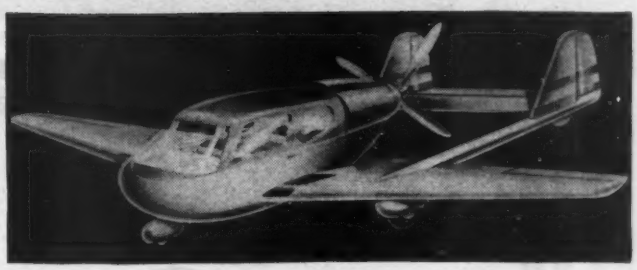
Poll by Minneapolis "Star-Journal & Tribune" finds two out of three Minnesotans plan either postwar business or pleasure jaunts on commercial airlines.

Willingness to pay up to 5c-per-mile fare is reported by 66 percent of airminded. Interest in flying planes was noted by 27 percent, and in ownership of craft by 21 percent.

Opinion checkup by "Woman's Home Companion" found 51 percent of those women who responded interested in flights to Europe "if round trips cost $200"; 64 percent were attracted by prospect of flights to South America; 88 percent said they had no objection to a member of family owning planes and 39 percent expressed desire to learn to fly.

Returns on questionnaire distributed to aviation-minded by Aircooled Motors Corp., Syracuse, N. Y., indicated 87 percent of those replying wanted monoplane as postwar craft, 51.3 percent prefer low-wings, and 64.5 percent desire a land plane as compared with 28 percent preferring an amphibian. Cruising speed of 125-150 mph. was most popular (39 percent), with 20 percent asking for 115-125 mph. More than half said 40-50 mph. is most practical landing speed. Cruising range of 500-600 mi. was specified by 30 percent. Majority spoke for metal fuselage and wing covering, while 57 percent requested seating capacity of four persons. Regarding engines: 57 percent voted for aircooled, horizontally opposed; 32 percent for 6 cylinders; 27 percent for geared engines; and 42 percent for 100-to-150-hp. plants.

Hamilton Standard announces successful 6,000-hr. test in cooperation with AA of a new lacquer anti-icing substance called Icelac. Sprayed onto propeller blades, lacquer is stated to last for hundreds of flying hours.



DESIGN FOR TOMORROW?

This sketch by Donald J. Wheeler, engineer with Boeing Aircraft Co., Seattle, won first prize of $1,000 war bond in professional class of recent "Plane You'd Like to Own" contest. As noted, Wheeler's proposal is for clean-lined twin-tailed family-type low-wing craft mounting aircooled pusher power plant. Conducted by magazine, "Popular Science," competition aimed to bring out preferences in peacetime personal-plane design, and wide interest was reflected by fact that more than 3,300 drawings were submitted.

TURBINE TALK

G. Geoffrey Smith, directing editor of British magazine "Flight," tells members of Wings Club, New York City, that development of gas turbine power plants for aircraft will progress faster than many in industry now believe possible. Noting advantages of rotary motion as against reciprocating, he pointed out that straight jet propulsion is of most value at extreme speeds and altitudes, and he envisioned widespread use of turbine-propeller combination for transports operating at lower altitudes and medium speeds. Seated (left to right) are Dr. Theodore von Karman of Caltech; J. Carroll Cone, Wings Club president; and W. D. Pawley of Inter-Continent Corp. (PAA photo)

AMERICA AT WAR

Aviation's Communique No. 35

Weakening steadily, able to fly less than one-tenth as many sorties daily as the Allies, the Luftwaffe fights on. Probably some Nazi guerilla airmen will be aloft to the last day. Germany's ability to take 34,000 tons of fire and explosive bombs in a week, dropped by warplane fleets of 5,000, and still produce while resisting the world's three great powers, continues to impress aviation commands.

Particularly interesting to all Army branches are current demonstrations of the ability of airborne infantry and artillery to go overhead of front-line resistance and take and hold ground back of the enemy. Here, failure of a British troop outfit to hold on till reinforcements could break through is a mere incident in the long-range picture of airborne power. Encirclement on the ground may one day lose its terrors, and belligerents may expect an army to drop on them, any hour, any place. Air supply of armies is second in importance only to the flying of soldiers themselves.

Concerning types of aircraft to be used by AAF after production cutbacks, Lt. Gen. Barney M. Giles, Deputy Commanding General and Chief of Air Staff, said recently that standardization would be on three basic fighters, four heavy and very heavy bomber types, and two medium bomber types. Over-all cutbacks will be about 40 percent when Germany quits.

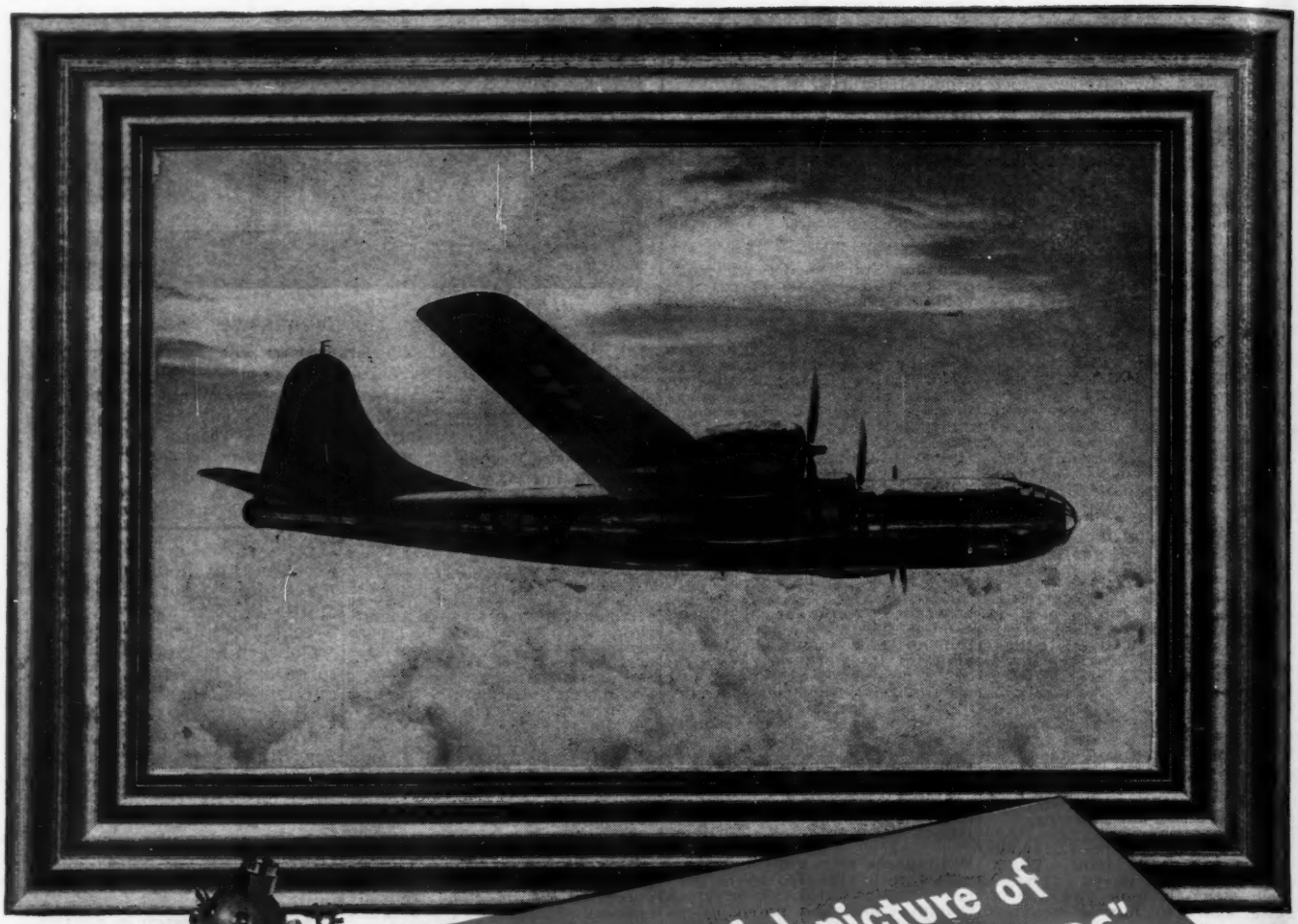
American airmen in all theaters are using an armor-piercing incendiary 50-cal. bullet that sets fire to enemy gasoline tanks, rendering self-sealing obsolete. Rocket missiles, now used by all belligerents—fired from ground, ship, and plane, also plane to plane—have great possibilities. Advantage is that the launching device is light as compared with a gun throwing equivalent demolition power. Rocket accuracy, so far, is not good. Army announces the new Thunderbolt XP-47N, with a longer range for attacking Japan, is in production, with regular P-47's tapering off. Thunderbolts have been packing the rockets, with little impairment to their performance.

Navy Uses "Jato"

Due to short takeoff runs on carrier decks, Navy is leading off with Jato — jet-assisted takeoff. Success seems inevitable; bomb, ammunition, and supply loads are greatly increased. Smoke interferes with following takeoff, but that will be licked. Jato has important commercial implications.

Navy announces the Vought F4U-1D has doubled its capacity, now carrying two 1,000-lb. bombs. The Banana River Naval Air Station, Florida, has perfected a beaching gear that doesn't need large handling crews.

Seekers of knowledge on the



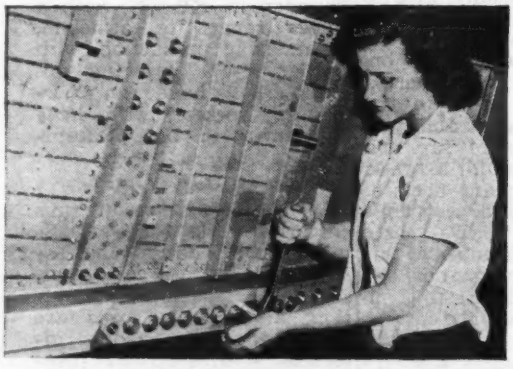
a beautiful picture of "MILLIONS OF FASTENERS"

A sizable segment of American industry shares in the production of the Boeing B-29. Like the old fable of the blind men and the elephant, the Superfortress means many things to many people. To us at National Screw it means the last word in fasteners.

Throughout this giant plane, both in the airplane proper and in the instruments and armament, *National* screws, bolts, nuts, studs, rivets, cotters and many special fasteners are used by the thousands.

Following are a few of the *National* fasteners in the B-29:

NAS and BAC close tolerance bolts.
NAS internal wrenching bolts.
BAC bearing bolts.
AN bolts, nuts and screws—complete line.
Carburetor Studs.
Instrument Screws.



Photograph shows National Screw AN hex head and NAS close tolerance bolts being used in fabrication of a main structure of the Boeing B-29 Superfortress.

National HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

war against Japan should read Office of War Information's report. It says the Japs are building about 1,500 airplanes per month. Our airmen are still beyond effective bombing range, except with the B-29's. To hit effectively, OWI says, we shall have to base within 500 to 600 mi. of objectives. The contrast between present bombing of Japan, and round-the-clock operations against Germany, are extreme—and still Germany fights. We're now in the Philippines, and as the Nips back toward home they can concentrate their air power withdrawn from outposts, and they probably can increase their aircraft production.

★ CANADIAN NOTES ★

By James Montagnes

To develop postwar civil flying, a three-man Canadian Air Transport Board has been set up. This body will regulate the recently enacted Canadian Aeronautics Act and also advise the government on ways and means of bringing about a rapid and well-planned expansion of air transport. R. A. C. Henry, of Montreal, has been named as CATB chairman for a period of 10 yr., while Air Vice Marshal Alan Ferier, Ottawa, was appointed for 7 yr., and J. O. Romeo Cachon, Montreal, for 4 yr.

Canadian Propellers of Montreal, subsidiary of Canadian Pratt & Whitney Aircraft, recently delivered its 10,000th propeller.

Control of deHavilland Aircraft of Canada, has been transferred from J. Grant Glassco, government controller, to a three-man board. The company was taken over by the Canadian government in connection with manufacture of the Mosquito.

★ CALLING NAMES ★

John S. Allard, formerly vice-pres. of Curtiss-Wright Corp., has been promoted from Colonel to Brigadier General, AAF. Gen. Allard, who is with 8th Air Force, entered Army in 1942 as Asst. Chief of Staff, 12th A. F.

Reginald E. Gillmor, president of Sperry Gyroscope, and Harry F. Vickers, president of Vickers, Inc., have been elected vice-presidents of Sperry Corp., parent organization of both companies. Gillmor and Vickers will continue to head their respective companies.

J. O. Almen, head of General Motors Research Laboratories' mechanical department in Detroit, has been awarded Manly Medal for his research and data on shot blasting to increase fatigue resistance in aircraft and engine parts.

All American Aviation elected following directors: **Halsey R. Bazley, Charles F. Benzel, W. Sam Carpenter III, Frank M. Donohue, Mrs. Richard C. du-Pont, Charles W. Wendt,** of Wilmington, and **Arthur P. Davis, George S. Leisure,** and **David Rawson** of N. Y. C. Officers re-elected by directors are: Pres., **H. R. Bazley;** v.-p. traffic, **Harry R. Stringer;** v.-p.-treas. **C. W. Wendt;** v.-p. manufacturing and development, **Edward E. Minor, Jr.;** secy. & gen. counsel, **Austin M. Zimmerman;** asst. secy. **Frank J. Trelease, Jr.;** asst. treas. **Harry S. Fries;** and comptroller, **Walter C. Gebelein.**

Aerco Corp., subsidiary of Transamerica Corp., announced retirement of **C. A. Herberts,** founder and president, and election of **Timothy E. Colvin** as new president and member of board of directors.

Joseph D. Boylan has been made regional cargo traffic manager for American Airlines.

Alfred Marchev, pres. of Republic Aviation Corp., is the new president of AWPC, East Coast.

J. G. Holland is named general attorney for Continental Air Lines. **Stan Johnson** has been made director of public relations.

Convair's Miami div. announces appointment of **Norman W. Storey** to take charge of contract terminations, and **R. L. Sullivan** as staff asst. to **A. R. Johnson,** div. manager. Company's Fort Worth div. process engineer, **J. A. Lapham,** has been named a regional director of ASTE.

Braniff Airways' **Capt. Merrel Brock** celebrated his 25th anniversary as a pilot. Capt. Brock joined Braniff in 1934.

American Casualty Co. & American Aviation & General Ins. Co. announces appointment of **Fred N. Davey** as v.-p. in charge of aviation insurance department.

Arney C. Leathers has been named chief of the Approach Control Center which CAA is opening in Bermuda for Navy.

Lieut. Col. Muri Estes, AAF, formerly chief pilot of PCA has been assigned to Bolivia as U. S. military air attache.

Capt. Otis E. Kline, veteran UAL pilot, has been elected a director of the Wayne Pump Co., Ft. Wayne, Ind.

Roy Martin, Post Office airmail superintendent, has been named Deputy Second Asst. Postmaster General.

Adam M. Butler was appointed head of Sparton School of Aeronautics' new vocational rehabilitation dept.

William T. Grant, pres. of the Business Men's Assurance Co., of Kansas City, Mo., has been elected a director of Aircraft Accessories Corp.

Northwest Airlines announced appointment of **D. C. Vaile** as asst. to Western traffic manager, with offices in Seattle.

James C. De Long becomes director of advertising for TWA.

Lockheed Aircraft Corp., announces appointment of **Roy Campbell, Jr.** as advertising manager, succeeding **Howard W. Cheney,** who resigned early this year.

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

What to do with surplus combat airplanes is one of Washington's most serious aviation problems. Tests indicate the labor cost of disassembly to segregate metals may be more than the scrap is worth. Yet, with metal resources seriously depleted by war, junkpiling these aircraft to let them disintegrate in oxydation would raise public criticism.

Nearly everybody concerned was pleased with the candor of CAA Administrator T. P. Wright in his statement regarding utility, safety, and price status of existing personal aircraft design with relation to the market. He said no single design is good enough on all three counts—that while the industry has done a fine job, it has a bigger one still to do.

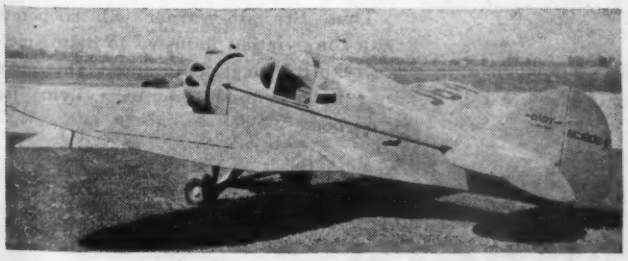
Organization of a broad system of transportation in the third dimension is one of the most difficult jobs the human race has yet undertaken. If the 50-nation international conference obtains agreement on just two or three basic principles, it will have done well. But there will be no rest from these problems in your lifetime.

Betting odds favor surface transportation to win, eventually, authorization to establish auxiliary air transport service. Combined voting power of rail, automotive, and shipping will steamroll the opposition. Odds are on the "chosen instrument" theory of home-flag foreign air services to lose, eventually, in favor of controlled competition. Voters want free opportunity for all comers.

The Stubblefield award goes to Army Public Relations for releasing a story about two helicopters which flew from the East Coast to Indiana in five days, making twelve stops, and averaging 65 mph.

Air shows and air races will resume, postwar. Aero Chamber of Commerce is already planning to demonstrate airplanes as safe, sane and sedate, economical and useful. There'll be "tours" with Aunt Rachel's picture in the handouts, interior design for wives, and engines for the man who doesn't know what's under the hood. As for races, the industry wants Army and Navy to be the dare-devils.

Official amazement, and disappointment, increases as the Germans, growing weaker, continue at press time to demonstrate ability of a people in total war to keep on producing and fighting under unprecedented air attack. The effect of air power on Japan will be watched hopefully, but closely, and if the Nips can take it, strategic aviation will be scheduled for a revaluation.



"UNDER NEW MANAGEMENT"

Ray Applegate, designer of Applegate Amphibians, has formed partnership with Romer Weyant, company v.-p., under name of Applegate & Weyant Engineering Co., which has purchased design, jigs and fixtures, and inventory of Dart Aircraft Corp. New organization plans to service Darts now in operation and to produce both amphibious craft and improved version of craft shown above. Applegate is currently making survey trip to locate manufacturing facilities.

"Moms—Ask Daddy to Go Up to 5000 Feet . . . And Find Out How Far We Can See"

THIS is no "dream scene." This is Mr. and Mrs. Tomorrow on a week-end trip . . . and little Betty doing some "back seat driving." Sooner than she thinks, tens of thousands of youngsters like her will be reading the simple instrument panels on family planes as casually as they read the speedometer on the family car.

Actually, the instrument panel of the post-war family plane will have a very familiar look. Simple . . . streamlined . . . easy to read . . . with dependable Stewart-Warner instruments telling at a glance all the driver needs to know.

Today, the post-war family plane is on active, non-combat duty. Stewart-Warner instruments ride in such planes. They're the same instruments that will make the air travel of tomorrow's families carefree, sure and casual.

Into these instruments go all the experience Stewart-Warner has gained in equipping millions of motor cars, power boats and industrial engines of every type. And the new knowledge gained in war will result in simple, accurate panels of instruments that will do the job.

Thus, Stewart-Warner will cooperate with the aviation industry to help America take its wings for granted. One more step in providing "low cost flying for everybody."

INSTRUMENTS BY
STEWART-WARNER CORPORATION
CHICAGO ILLINOIS
Another Product of STEWART WARNER

September Output is 7,598 Planes, Down 341; W-11 Schedule Calls for 101,944 Craft in '44

. . . New cutbacks are reported; lags on A-26's and B-29's . . . Three industry puzzles . . . Payment ruling smooths contract termination . . . Trainers sell, but combat craft are problem.

Numerical warplane production has declined each month, except in May, for six months. The all-war high point was last March, with a total of 9,118 units. Production for April was 8,343; May, 8,902; June, 8,049; July, 8,000; August, 7,939; and September, 7,598.

The September total represented 92,700,000 lb. including spares; or about 1,200,000 lb. less than August.

Increasing emphasis on heavy bombers, plus constant design changes, plus manpower shortage, caused the leveling off short of the anticipated 10,000 - per - month rate. In addition to above causes, recently-ordered program cutbacks are now contributing to the declining monthly rate.

Production of Boeing B-29's reached a new high in September. At the same time, J. A. Krug, WPB chairman, succeeding Donald Nelson, said labor deficiencies are holding super-bomber production behind expectations, despite efforts to improve labor recruiting and work efficiency. Mr. Krug criticized the public for shifting its interest and energies to postwar matters.

So great is the current backlog of other warplanes, in action, in pipelines, and in process, that military commands are not deeply concerned about any category except that of the new big bombers which alone are able to attack Japan heavily from present nearest bases.

W-11 Calls for 101,944 Craft in '44

WPB'S new W-11 aircraft production schedule, replacing schedule W-10, cuts the four-engine bomber program from 18,081 to 17,955 in 1944, and from 16,161 to 12,862 in 1945. Medium two-engine bombers are reduced slightly to 7,373 this year, and increased from 3,121 to 3,842 in 1945. Light two-engine and single-engine bombers are reduced in both years. Fighters are cut from 42,861 to 40,595 this year, and from 48,361 to 43,526 in 1945.

Total of combat planes is reduced 3,640 units this year, and 10,907 next year. There are slight increases in trainers, liaison, and special purpose categories in 1945. The total aircraft program for 1944 is 101,944, reduced from 106,745. Total program for 1945 is 96,824, reduced from 107,466, a cut of 10,642 for next year.

New Cutbacks Reported; Lags on A-26's, B-29's

The largest company cutback went to the Lockheed plant at Burbank, where an order for 1,947 P-38 Lightnings was canceled. War Department said this was to make way for a new type of plane.

A reduction of 1,286 C-47's from the Douglas plant output at Oklahoma City was the second largest, numerically. This reduction takes effect slowly through all of next year.

An increase in the output of Curtiss C-46 Commandos was indicated by the War Department, eliminating future production of 435 P-40's. The small remaining schedule of Boeing Kaydet trainers was eliminated to allow for more production pressure on B-29's at Wichita. Bell's schedule of P-63 Kingcobras was cut by 325 units, but the company will continue at top level with more steam behind other products.

Psychological effect of aircraft cutback orders, and of battle victory news, make it extremely difficult for WPB, the armed forces, and the manufacturers to maintain efficiency of management and labor. In urging the people to stay on the job, WPB Chairman Krug pointed out that the 1944 program of Douglas A-26 production was only 27 percent completed through August; B-29's, 42 percent; heavy duty trucks, 45 percent; and heavy artillery ammunition, 50 percent.

These were cited merely as examples. After V-E day, Mr. Krug said, most of the programs that now seem difficult will be easy. He said there is no prospect of cutbacks in the A-26 Invader and B-29 Superfortress program.

Payment Ruling Smooths Contract Termination

The aircraft industry won an important point in its program for a workable contract termination policy when Robert H. Hinckley, director of contract settlement, issued a regulation authorizing contracting officers of Army, Navy, and other procurement agencies, to pay 75 percent of manufacturers' claims and up to 90 percent within 30 days of application, with additional payments upon submission of adequate accounting data. Payments are made to prime contractors on their own applications, and to subcontractors on applications made through their prime contractors.

The 75 percent payment is alternative with the T-loan program as a source of conversion funds. The T-loan is administered by the Federal Reserve System. Contracting officers appear to have almost unlimited power in making settlements, but this has not yet been tested.

Three Industry Puzzles

Presidents and top officials of 15 leading aircraft manufacturers, meeting last month in Washington during sessions of the Aeronautical Chamber of Commerce, were mainly concerned about survival of their companies after the war. Three principal problems, outlined by E. E. Wilson, chairman of the Chamber's Board of Governors, are contract termination, disposal of surplus aircraft, and surplus plants.

First thing stated to be needed is quick termination of contracts and immediate payment from the government, to provide funds with which to initiate peacetime projects. The aircraft men hope they will be allocated sufficient labor to get started on civilian production when they are released from war work.

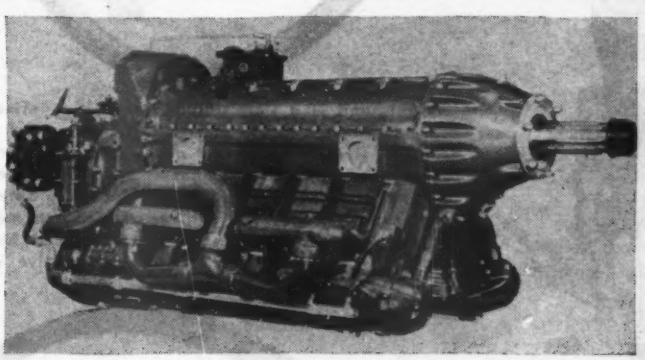
Trainers Sell, But Combat Craft are Problem

Nearly all of the 5,400 War Training Service (CAA) light planes have been sold at auction, and for satisfactory prices. Next will be offered about 6,000 heavier military training planes. These will sell much slower, being less desirable, and prices may break down.

Most difficult job facing the aviation division of the Surplus War Property Administration is disposal of combat craft. A test breakdown of a B-24 shows that man-hours required in the disassembly job cost more than the salvage can be sold for. Both domestic and foreign U. S. sources of metals have been seriously depleted by this war.

It is expected the public won't like scrapping of any planes. Probably a way will be found to stock-pile useless warplanes, even if it costs money.

It will be some time before any number of military transport planes will be declared surplus. However, SWPA's pricing policy on surplus planes includes a program for transport planes, to be inaugurated when the time comes. Transports are broken down into two groups: Multi-engine equipment of more than 17,500 lb. gross, and single- and multi-engined planes of less than that weight but more than 5,000 lb.,—in general calculated for main lines and the feeder lines, respectively.



NEW RANGER FOR PEACE

With takeoff rating of 700 hp. and low weight of 870 lb., this new engine is intended for postwar commercial applications. Maker is Ranger Aircraft Engines, Div. of Fairchild, which believes power plant will be specifically suitable for use in feeder-line planes. Engine is 12-cyl. inverted-V aircooled type, and it measures 74.92 in. long, 33.28 in. wide, and 31.11 in. high. Company states it is prepared to go into production as soon as war ends.

Hydraulic LIMIT SWITCH

This unit is a flap stop valve. It is in effect a hydraulic limit switch which prevents damage to the surrounding structure by shutting off the flow of hydraulic oil to the flap drive actuator at the end of the normal flap travel. We have manufactured this unit for a number of years for use on a very successful fighter plane.

The unit as shown has recently been granted "yellow dot" approval by the A. A. F. and pronounced satisfactory for extreme low temperature operation.

The valve body is a permanent molded heat-treated aluminum casting. All machine work is of high precision. This valve is indicative of fine performance obtainable with VARD hydraulic equipment.

VARD INC.
PASADENA 8, CALIFORNIA

Prices will be based on average manufacturing cost of base models during the first half of 1944. Purchasers are warned that prices may be revised downward. This may cause early airline acquisitions of surplus planes to be made on a lease or terminable installment basis. Transport planes will be allocated among the airlines.

★ ASSEMBLY LINES ★

The 10,000th P-47 Thunderbolt was rolled from Republic Aviation's Farmingdale assembly line in September, less than 2½ yr. after first P-47 was delivered to AAF. Ship No. 10,000 represented 6,290 man-hours.

Convair has TBY-2 Sea Wolf (Vought design) in production at Allentown, Pa., plant. New torpedo bomber weighs about eight tons, carries pilot, gunner, radioman, and bombardier.

Last A-20 Havoc fighter-bomber left Douglas Santa Monica plant in September. Assembly line was being torn down behind 7,098th plane to make room for increased production of 4-engine transports. Havoc type is being supplanted by company's newer, faster, more heavily armed A-26 Invader.

Lockheed has revised production schedules to handle five type craft—new AAF fighter, Army's C-69 Constellation, P-38, B-17, and Navy's PV Ventura. Latest contracts for new fighter, P-38, and B-17 raised company's backlog to over a billion dollars.

Nash-Kelvinator's first Sikorsky XR-6 helicopter has been flown.

Boeing-Douglas-Lockheed B-17 group delivered 10,001st Flying Fortress in October. Boeing has made 6,143, Douglas 1,982, and Lockheed 1,876. Each company contributed a ship for "over the mark" ceremony.

Bendix Aviation Corp., Illinois div., publicly demonstrated value of exploded views in production assembly by having an 11-yr.-old boy put together correctly 500-odd parts of company's injection carburetor in less than 2 hr.

Convair's Miami div. plant reduced lost time accidents by 75.3 percent in 12 mo. ending Aug. 31. For same period year ago, division averaged 23.65 lost time accidents per million man-hours, whereas this time average was but 5.85. In first eight months of this year the accidents fell to 4.16 per million man-hours, compared with an average of 15.25 in first 8 mo. of '43.

Adel Precision Products Corp., Burbank, Calif., has received Army and Navy orders for over $3,000,000 worth of aircraft hydraulic controls.

Douglas announces it has topped industry in number of individual WPB awards for plant suggestions issued this year. Santa Monica plant received 102 awards out of 138 suggestions submitted.

Fairchild Camera & Instrument Corp., N. Y., has been commended by Army-Navy on its field service organization set up in all war theatres.

North American Aviation reports production of 80 percent more Mustangs at Inglewood plant today than a year ago, also average monthly output of Mitchells at Kansas City plant is reported 66 percent greater than in '43. Company states it has been able to reduce average cost of P-51's to government by more than 18.5 and of B-25's of 26.5 per cent over costs on Jan. 1.

Preparation of standards, specifications, and test codes designed properly to adapt aircraft electrical equipment and systems for combat requirements has been undertaken jointly by AWPC, AIEE, SASC, NEMA, and SAE at Air Technical Service Command's request. Program will enable industry to establish standards which will eliminate need and cost of subsequent testing, make industry study and findings practical basis for future Army-Navy specifications.

Thompson Aircraft Products Co. is reported to have WPB approval for purchase and installation of some $475,000 worth of new machinery, tools, and equipment to make an additional aircraft engine device.

Stating ample aluminum ingot is on hand, WPB has ordered further cutbacks in output at four government-owned facilities. In addition, Aluminum Co. of America will cut down production at four plants.

Success of Curtiss-Wright's "Back Up Our Battleskies" war production drive has brought issue of Supplement No. 3. Theme of this new comprehensive appeal to workers is "Stay on the job."

★ FOR THE RECORD ★

Wickwire Spencer Steel Co. has moved its purchasing department from N. Y. C. to Buffalo. Company's Mechanical Specialties Div. has moved from N. Y. to Clinton, Mass.

Whitehead Co., Cleveland, has opened a direct Chicago sales office in Pure Oil Building. New office is headed by C. T. Craig, former director of purchases.

Lear, Inc., is new name of Lear Avia, Inc., Piqua, Ohio. Because of company's extension into outside fields it was considered best to drop word "Avia".

U. S.-Mengel Plywoods has now opened additional distributing units in Atlanta, Ga., and in New Orleans, La. Plans call for new units in other cities.

National Battery Co. will build a new testing laboratory for its Gould Commercial Div. plant at Depew, N. Y.

Cook Electric Co., Chicago, has added Metal Fusion Corp. of America as subsidiary.

Optimus Equipment Co. has been organized in Matawan, N. J., to make metal-cleaning units. It will operate closely with Hanson-Van Winkle-Munning Co.

Mitchell Mfg. Co., Chicago, lighting equipment maker, has joined with Tru-Ad Co. of Los Angeles, Cal. Los Angeles factory will operate as Mitchell Mfg. Co., Tru-Art Div.

George Gorton Machine Co., of Racine, Wis., machine tool maker, has appointed Russell, Holbrook & Henderson, N. Y. C., as exclusive New England representative.

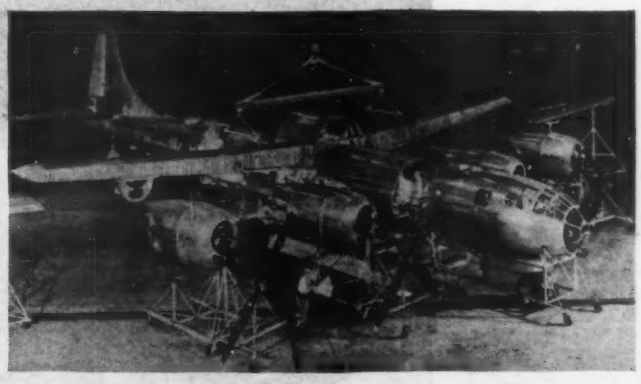
Nigg Engineering Co., Covina, Calif., has appointed United-Carr Fastener Corp., Cambridge, Mass., its exclusive sales representative for Nigg universal adjustable fastener stud for entire U. S. except for Calif., Oregon, and Wash. Pacific coast inquiries should be sent to Covina office.

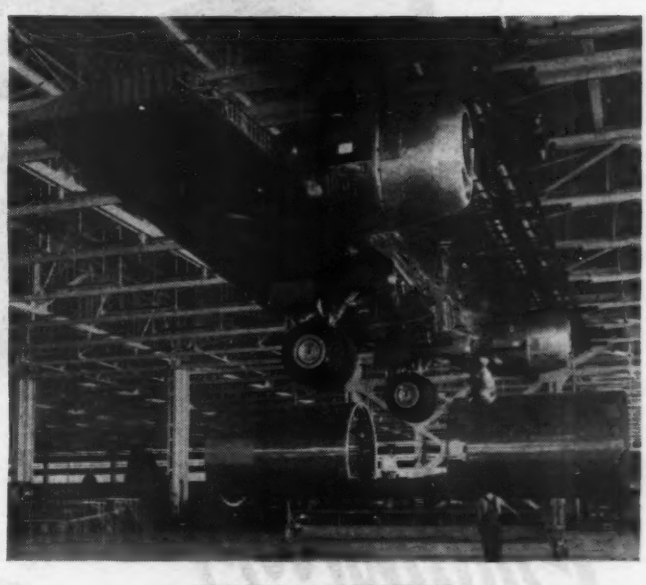
Firestone Tire & Rubber Co. will offer complete line of aircraft products, accessories, and supplies through dealer-merchandising program. First companies franchised are Page Airways Co., Rochester, N. Y., and Municipal Airport & Flights, Inc., Cleveland.

Union Carbide & Carbon Corp. announces formation of Plastics Group as fifth products division of company.

General Controls Co., Glendale, Calif., valves and parts maker, has opened a new Kansas City branch at 421 Southwest Blvd., Kansas City, Mo., with Robert Courtney in charge as branch manager.

Fairchild Engine & Aircraft Corp., N. Y., is moving operations of its Duramold Div. from N. Y. to Burlington, N. C., where work will be headed by T. Kelly Pierce, div. asst. mgr.





HOW SHE GOES TOGETHER

Just what does it take to assemble one of Boeing's hugh B-29 Superfortresses? These striking photos, snapped at company's Wichita plant, give a graphic idea. Top: "Exploded" view—not a sketch but the actual components—vividly illustrates all sections in their relative positions before final joining. In fabrication, these parts come together at scheduled points along production line. Above: Here, 17-ton main wing section of B-29—already fitted with dual wheels of main undercarriage and with two of four engines mounted—is lowered into central portion of fuselage. Latter is jacked up to give ¼-in. spread as the two perfect-fit units come together. When jacks are removed, slack is taken up and pre-bored bolt holes are exactly aligned.

★ KNOW-HOWS ★

Republic uses a photo-reproduction process to turn out engineering layouts for its subcontractors and Evansville plant. Called Ray-Production, Method uses a patented luminous coating on metal to make master negatives of drawings. In addition to time saving and economy, method enables Republic to handle its' lofting needs with 67 men.

GE has designed an automatic engine cooling flap regulator employing a temperature sensitive material which, acting as a "mechanical flight engineer," regulates flaps at predetermined temperatures. Flaps never open wider than necessary, thus reducing wind resistance and increasing plane speeds.

Interstate Aircraft is employing sawdust as a cleaning compound for removing dirt and oil from aircraft parts after magnetic inspection and prior to further handling. Parts are tumbled or rolled in a bin, and adhering sawdust is blown off with air hose.

Grasshopper turns HUNTER

The "Grasshopper" . . . the smallest of all U. S. military planes . . . earned its name in action. Flown by an artillery officer, it hops up from a cow pasture or a runway made by a bulldozer, climbs its scant one or two thousand feet and hovers to direct the fire of the artillery below. If attacked, it can swoop down to safety, hug the ground and hedgehop back to its Artillery base.

Wire and cable have helped to give the "Grasshopper" the dependability to carry out its job . . . wire for ignition . . . instruments . . . radio. Every type of wire and cable manufactured by Auto-Lite for modern aviation meets the rigid demands of this exacting industry. We have had numerous requests for Form No. C-503 covering Steelductor Cable, and Form No. 838 on Low Tension Cable. Write for your copies today.

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BACK THE ATTACK—BUY AND KEEP MORE WAR BONDS

AUTO-LITE AIRCRAFT WIRE and CABLE

TUNE IN "EVERYTHING FOR THE BOYS" STARRING DICK HAYMES — EVERY TUESDAY NIGHT — NBC NETWORK

International Civil Aviation Parley Opens; CAB Route Hearings Seen as Long Grind

. . . NA opens service into N. Y.; purchases CW-20 planes . . . Compete for "gateways" . . . Douglas craft accented in airline orders . . . Carrier taxes studied . . . PCA and EAL buy planes . . . ATC operations of AA and UAL revealed . . . SAE meeting considers airliner improvements.

The United States took the initiative in world air transport affairs when the State Department invited representatives of some 55 nations to participate in the International Civil Aviation Conference, which began November 1 in Chicago.

Program suggested in the Department's invitation is: (1) Arrangement for immediate establishment of "provisional" routes which would serve during the war-to-peace transition period; (2) establishment of an interim council which will collect and analyze experience looking toward a permanent world air transport organization and operating system; (3) study of the preliminary groundwork of the proposed over-all aviation convention.

It is assumed that Russia and Britain had agreed to the U. S. proposed agenda for the conference during recent exploratory meetings. Inclusion of 55 nations in current deliberations indicates to observers that while the United States intends to secure a position in world air commerce commensurate with its volume of traffic and its part in the war, it will respect the aviation interests of small countries.

The State Department, and presumably delegates from the other countries having external air plans, want each nation to grant rights of free transit and technical landing to all others, at least until such liberties can be tried out for effect. Proposals that airmen of one sovereignty may fly over territory of another, without the latter's knowledge or consent, are not taken seriously.

Though the nations try to reach legal agreements, the contest for position in world air trade will be continuous and determined, and success will always be a measure of economic and military strength.

CAB's Route Hearings Seen as Long Grind

While the 55-nation conference tries to form a world airline pattern, the CAB continues hearings on a huge backlog of applications for American flag foreign routes. To save time the Board consolidates the applications in geographical groups for hearing purposes. Hearings recently were completed on a group of applications, by airline operators and by steamship companies, to fly from the West Coast to Hawaii.

A group of 16 applicants for U. S.-Latin America routes has been heard. Some of the applicants are big steamship companies: United Fruit, Grace Line, Moore-McCormack, Waterman, Atlantic, Gulf and West Indies, and the rest are airline companies.

Important issues are involved. Arguments by applicants and witnesses over chosen instrument or controlled competition foreign policy will influence Congress; the same is true of controversy on the demand by surface transportation for rights in the air; future relations between North and South America will be vitally affected by intercontinental air transport; and the future of the individual applicants is in the balance as examiners' recommendations are being formed. Hearings on the Atlantic route applications were started October 16.

It will be months before the Board can digest the large volume of data and opinion which will be submitted to it by the examiners. There will be opinions and orders on each applicant, but they probably will be handed down in groups as organized for hearing.

The Board will attempt to authorize routes, under a policy of controlled competition in accordance with present law, on the pattern of its recently proposed U. S. flag world air map. The "interim" or temporary routes proposed by the State Department for liberated and other countries at the 55-nation conference, does not affect certificates to be granted by CAB, although the Board has issued, and may issue more, temporary certificates.

NA Opens Service Into N. Y.; Buys CW-20's

National Airlines has started operations from the South into New York, the second East Coastwise service, the seventh tenant at La Guardia Field, and the first at Idlewild, Long Island. NA will use the Eastern Air Line route temporarily, later moving nearer the shore. Lockheed Lodestars are being flown; other equipment is to become available. Both Eastern and National are applicants for extensions to Latin American countries.

George T. Baker, National president, proposes "cabin" class passenger fares one-third less than "first class." His company has ordered 16 Curtiss CW-20 transports (commercial version of C-46 Commando).

CRAFT-WITHIN-A-CRAFT

How Army Sikorsky helicopters are quickly whisked to other side of world is—literally—an "inside" story. Rotor craft is here seen being unloaded at India base after flight from U. S. in belly of Curtiss Commando. (Press Association photo)

Douglas Craft Accented in Airline Orders

Contracts for over $60,000,000 worth of Douglas DC-4's and DC-6's for postwar delivery to United Air Lines, Pan American-Grace, Eastern Airlines, American Airlines, Penn-Central, and probably others, has led some observers to believe that the airline system may standardize extensively on Douglas equipment after the war, just as it did in the '30's. Reduced cost of planes and parts is cited as an advantage of standardization.

The Army will use its influence toward apportionment of civilian aircraft production, so that numerous experienced producers will be kept intact for emergency. Manufacturers like Lockheed, Martin, Curtiss-Wright, Boeing, Fairchild, and others, who have up-to-date designs, will drive ahead for airline business.

Compete for "Gateways"

Each of several cities—New York, Miami, New Orleans, Dallas, Jacksonville, and others—have been claiming special merits as an air "gateway" to countries south of the border. Probably several of them will become ports of entry and departure for lines to the south.

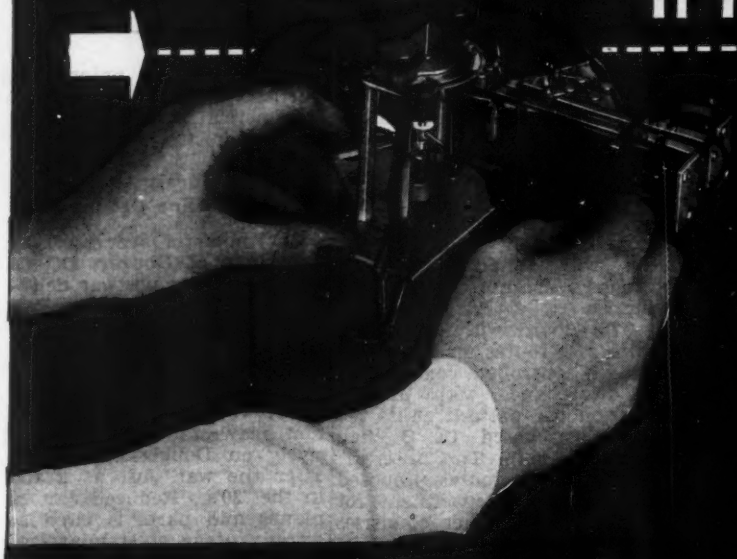
Of course, airways do not actually need gateways, as highways and railroads and shipping lines do. When there is enough traffic between Dallas and Rio, for instance, airlines may go the straight way, without bothering with gateways. This is one reason why some authorities believe small aircraft will have the advantage over larger ones.

PCA and EAL Buy Planes

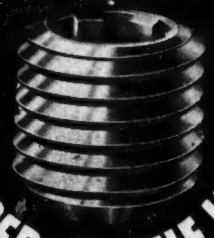
Pennsylvania - Central Airlines has contracted with Douglas for 15 DC-4 transport planes for delivery "within several months" after peace. Total amount of the contract is $15,000,000. PCA links nearly 50 cities in the industrial East, North, and South. Pres. C. Bedell Monro asserted that this order constitutes PCA's initial requirements for postwar expansion of routes and service, and that further addition to the fleet will be made as required.

Eastern Air Lines followed with announcement that it is making a $25,000,000 expansion of its fleet through pur-

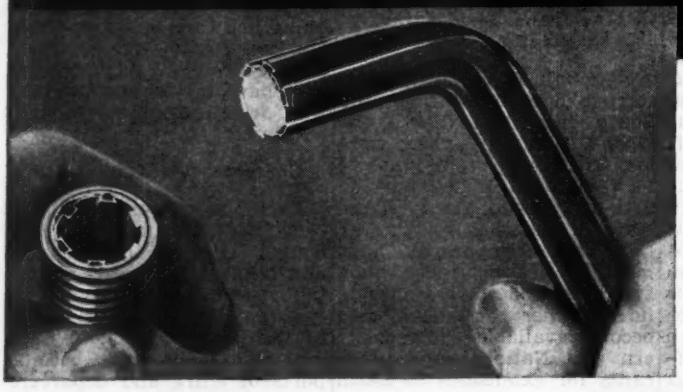
If It's Hard To Get At



it's Easy with...



THE SCREW THAT'S GEARED TO THE KEY



EASIER, FASTER ASSEMBLIES . . . greater holding power . . . convenient disassembly . . . are the reasons why Bristo Multiple-Spline Socket Set Screws are being used in tremendous quantities now that it is so important to specify the best. To accommodate greatly enlarged demand, manufacturing facilities have again been increased — this time by 25% — and further expansion is being planned.

THE TIGHTEST-SETTING SMALL SCREW ON THE MARKET

When the fastening point is awkwardly located or so small that it's hard to get at . . . or where vibration will be encountered . . . plan on using Bristo Screws.

The unique multiple spline design *gears* the screw to the key — for convenience in handling . . . and to utilize greater wrenching force without damage. The Bristo screw can be turned far beyond the point where an ordinary screw would burst or at least round out. Sizes as small as No. 4 wire can be set to withstand real vibration. Yet if adjustments need to be made, a flick of the key will loosen the screw.

Specified by leading aircraft and communications equipment manufacturers; ideal for electrical appliances, cameras, motor assemblies, instruments, etc. See other applications listed in THOMAS' REGISTER.

WHY "BRISTO" MEANS "TIGHTER"

Bristo: No expanding pressure; the key pulls the screw around

BRISTO MULTIPLE-SPLINE SOCKET SET SCREWS

GEARED TO THE KEY — FOR FASTER, EASIER, TIGHTER SETTING

The BRISTOL Company
MILL SUPPLY DIVISION

chase of Curtiss CW-20's and Douglas DC-4's. Capt. Rickenbacker stated his line hopes to begin operation of the Commando-type 20's by the fall of '45 and the 4's as soon thereafter as possible.

Carrier Taxes Studied

CAB has appointed a 20-man advisory committee to assist in a study on multiple taxation of air carriers, under the chairmanship of Board Member Oswald Ryan. Committeemen were selected from the various activities related to the subject of taxation of air carriers. The study is being made pursuant to a Congressional act, following the Supreme Court's decision against Northwest Airlines in the Minnesota tax case.

ATC Operations of AA and UAL Revealed

Details meanwhile were revealed on American Airlines' global operations for the ATC. In the period Aug. 1943 to July 1944 alone, the line flew 11,634,309 mi. in transocean operations. Breakdown of this figure was North Atlantic, 6,078,425 mi.; South Atlantic, 2,296,165; and other oceans, 3,251,719. Passengers carried totaled 23,987.

Extent of the operations are indicated by the fact that in the period named there were 2,690 Atlantic crossings. Currently the company is averaging seven round trips daily over the North Atlantic.

A chronology was given by AA of operations since Pearl Harbor, also details on training assignments, modification services, research services, and advisory services.

Further, United Air Lines reported completion of its 1,500th flight across the Pacific carrying personnel and materials to the Far East war theater for the ATC. United record shows about 11,000,000 mi. flown over the 7,350-mi. route between California, Hawaii, and Australia since operations began late in '42. Two daily round trips are now flown with 20 Douglas C-54's furnished to UAL by ATC.

Average elapsed time for the westbound flight from San Francisco to Townsville, Australia, with stops at Honolulu, Canton Island, Tarawa, Guadalcanal, and Port Moresby, is 50 hr. Passengers have totalled 38,990; cargo, 6,434,619 lb.; and mail, 6,030,512 lb.

SAE Meeting Considers Airliner Improvements

Transport aviation got the accent in the Oct. 5-7 SAE National Aircraft Engineering & Production Meeting in Los Angeles. Leading off were two companion papers, one by E. F. Burton and Carlos Wood of Douglas, and the other by Reagan Stunkel of Lockheed. The subsequent discussion was dominated by airline representatives whose theme was that transport plane designs still leave much room for improvement.

Airline spokesmen contended that past designs almost invariably fell short in at least one of these basic factors—safety, speed, comfort, and cost. Review by operator representatives prior to production was advised. Fire detection and control was specified as deficient.

It was indicated that experience proved 13 hr. utilization as satisfactory because weather, scheduling, traffic necessities, and customer whims will limit utilization to approximately that time. One line's experience pointed to an average of 1 man-hour per hour of flight per ton of weight as average maintenance time.

Later, a paper by Henry Dreyfuss, New York industrial designer, contended that big planes operating over long routes would have walk-around and also recreational space. Countering was argument that fewer such "frills" and greater speed would better solve passenger boredom and fatigue problems.

Postwar Pickup Plane Features Outlined

Basic features for the design of a combination passenger-pickup plane were pointed out recently by A. B. Schultz, chief engineer of All American Aviation. Company has been investigating the possibilities of adapting the service to include passengers, the plan being to make landings only when necessary for the accommodation of passengers; otherwise the mail and express would be picked up and delivered in flight as it is now.

Gross weight of the airplane should be about 15,000 lb. to provide for 12 passengers and baggage, pilot and co-pilot, 300 lb. of through express, 200 lb. of pickup equipment, 1,500 lb. of pickup cargo capacity, and 500 mi. range with the customary reserves. Cruising speed is put at 175 mph. Controllability at 80 mph. would be desirable.

It may be necessary to obtain engines capable of 100 percent boost for emergency takeoff, either by water injection or other means. Addition of rocket clusters in the tail of each nacelle for emergency boost requirements, operable in case of critical engine failure, may be a not-too-distant solution to this problem.

Other features were detailed by Mr. Schultz in his paper read before the Institute of the Aeronautical Sciences in the recent Air Transport Meeting in Washington, D. C.

UP ON AIR

Giant pneumatic pillow jacks, new addition to standard AAF equipment, are used to lift airplanes which have made crash landings on soft ground. Improving on original German idea, ATSC devised 6½-ft.-sq. bag which can support 12 tons. Only two are needed to lift most planes, while B-24 takes four, and B-29 eight. Sets of three bags with gas-engine-driven blower weigh 220 lb. (ATSC photo)

★ CROSS COUNTRY ★

UAL is circulating an illustrated questionnaire booklet to its patrons asking suggestions in planning such things as cabin interiors and facilities of its postwar DC-4 and DC-6 airliners. Company is also putting out a new 100-page guide for use of its traffic and reservations personnel and to replace numerous timetables and reference books.

Northwest Airlines has completed installation of a system-wide private line teletype circuit linking all stations on its Chicago-Pacific Northwest routes.

PCA has adopted new insignia, with initials PCA on a winged background and carrying accompanying slogan, "The Capital Airline."

AA's traffic planning committee has devised new speedy system of handling seat reservations on company's routes between N. Y., Boston, and Chicago, and Chicago and Ft. Worth. Called "Sell & Record," method has cut down time between request and confirmation on seats, frequently to record time of about 30 sec., whereas old way often took 2 hr.

Air Transport Assn. of America has released 6th edition of Little Known Facts, containing data on airline operations since industry's beginning in 1926. Information formerly withheld for security reasons is now included.

Goodyear Aircraft Corp. in statement to CAB, calls for further consideration of lighter-than-air craft in planning future scheduled airline operations on transocean routes.

Business research department of Curtiss-Wright has issued study titled, "Air Transportation in the Immediate Post-War Future", dealing with equipment requirements, international air traffic, transportation rates, and discussing postwar surplus plane picture.

An ATC Douglas C-54 recently was flown from San Francisco to Honolulu (2,415 mi.) in 10½ hr. Good tail winds helped clip full hour from old time.

PAA announces establishment of regular airmail, passenger, and cargo service between Miami and Leopoldville, Belgian Congo. Twice-monthly round trips are scheduled. One-day round-trip Clipper service between Miami and San Juan, Puerto Rico, has also been inaugurated, and new night flights have been announced between Brownsville, Texas, and Mexico City, linking N. Y. with Mexican capital in cooperation with EAL. Panair do Brasil, nationalized affiliate of PAA, has doubled night flying schedules between Rio de Janeiro and Sao Paulo.

Recent applications by PAA to CAB include requests for routes and extensions to reach Tokyo, Shanghai, Paris, Athens, Rome, Moscow, Stockholm, and Oslo, and also an extension to Calcutta, India.

Port of N. Y. Authority has recommended adoption of a pattern of eight basic direct one-carrier air routes between N. J.-N. Y. port district and points in South America. Port Authority states distances via routes now flown range from 7 to 45 percent greater than suggested routes.

DC-4's and DC-6's recently ordered by AA, Panagra, and UAL will be equipped with basic 13-ft. Hamilton Standard three-bladed Hydromatic propellers.

Dept. of Commerce and Edward S. Evans Transportation Research have issued a survey on postwar air transport cost and markets for lettuce.

Recent developments in field of air transport were disclosed in papers presented at I.A.S. Air Transport Meeting in Washington, D. C. Some of subjects: Feeder line operations, use of cargo gliders, developments in air traffic control, and review of aerodynamics of flight load factors in relations to safety regulations.

TWA's Boeing Stratoliners will go back into company's service again as soon as modifications on planes are completed at Boeing's Seattle plant. Returned by ATC, refinished 307's will

There's More to Stainless Tubing than Analysis

In analysis, two pieces of stainless tubing are alike. But there the likeness stops. Plus values resulting from long experience then take over. Since Carpenter first pioneered in developing Welded Stainless Tubing, we have worked with engineers to help improve processes and products. The accumulated "know how" is yours for the asking. We'll be glad to help whenever you run up against trouble in selecting or fabricating corrosion and heat-resistant material.

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have Flying Fortress wings, landing gear, tail surfaces, and newer, more powerful engines.

Springfield Feeder Air Line has submitted application to CAB for service covering Springfield, N. Y. C., Boston, Albany, Providence, Hyannis, and Hartford. Arrangements have been made to use La Guardia Field as the N. Y. terminus.

Air Express Div., REA, reports that total of 250,970 shipments were handled for nation's commercial airlines in the first seven months of this year, a gain of 12.3 percent over same period last year. Number of shipments in August totaled 37,293, a gain of 10.9 over previous month.

★ FLIGHT OPERATIONS ★

UAL flew 43,865,900 revenue passenger-miles during September (a 29 percent gain over same month in 1943), and 2,185,934 ton-miles of mail and express were handled. Company is currently flying 95,000 mi. daily.

Braniff Airways flew a total of 491,035 revenue miles and 24,-236 revenue passengers in August, completing 99.08 percent of all flights scheduled.

Northwest Airlines carried an estimated 18,755 revenue passengers in August. Mail and express totaled 665,460 lb.

PCA in Aug. flew a total of 53,-550 passengers, a 10 percent increase over same month in 1943, and 1,075,807 lb. of airmail and express were carried.

Continental Air Lines totaled 2,544,612 passenger-miles in August. Load factor for all routes averaged 92.9 percent, an increase of 1.4 percent over July.

PAA's fleet of flying boats transported 726,172 lb. of mail and express in and out of La Guardia Field during August, termed a 300 percent increase since the first of the year. Latin American division registered a 33 percent gain in passenger-miles flown and a 155 percent increase in express ton-miles during 30-day period, passengers numbering 24,346, a gain of 25 per cent over same period in '43.

National Air Lines has carried 527 passengers on its Florida, New Orleans-N. Y. C. route since opening of this service last month. Load factor between N. Y. C. and Jacksonville has been 98.92 percent. Flying nonstop, Florida-N. Y. C. time of 3 hr. 50 min. was set by NAL plane.

EAL states it has completed two consecutive months of operations with 100 percent efficiency (June and July). In domestic operations, 43,000,000 revenue passenger-miles were flown. Cargo planes are averaging 20,000,000 lb.-mi. a day carrying express and mail.

Hawaiian Airlines reports 26.93 percent gain in first six months of 1944 over same period last year in handling air cargo. Large portion of increased poundage was made by shipment of vegetables and fruits to Honolulu markets.

Western Air Lines had an 8.70 percent gain in express cargoes flown in first six months of 1944 on its Calif.-Canada system, recording 265,867,635 lb.-mi.

The Southwest Pacific airline operated by DAT (Directorate of Air Transport) in support of forward fighting zones flew 16,-039,301 mi. during first half of '44. Some 350,000 high priority passengers were carried, with carried, with 1,651 patients evacuated from New Guinea to Australia, and 58,000 tons of cargo were hauled.

★ ALONG THE APRON ★

UAL's pilot training school in Denver has graduated 352 men since Pearl Harbor to handle company's fleet. Depending on pilot's previous experience, course takes from 60-110 days. About twelve men graduate each month and are assigned as first officers on UAL system.

5,000 AAF, Navy, and RAF avigation cadets have graduated from training section run by PAA from Aug. 1940 to Sept. 1944, when school was closed by War Dept. Record is 2,079,000 mi. flown with perfect safety.

United Flying Service, Vail Field, Los Angeles, is reported selling an average of a plane a day in addition to affording service and overhaul facilities. From 100 to 125 ships are stored at field and many have been sold for owners.

Some 280 Tennessee high school, college, and university teachers are being prepared to teach aviation under a scholarship plan by state's Bureau of Aeronautics covering equivalent of 12 wk. of ground school and 10 wk. of dual flying.

Flight instruction for civilian students at Alabama Institute of Aeronautics, Tuscaloosa, has been resumed with termination of War Dept.'s flight training contract with school.

State Departments of Education of Wisconsin, Illinois, Colorado, California, Connecticut, and of Pennsylvania have recommended flight experience of 4-hr. dual for each pupil in local high school aviation classes.

EMULATES MAPLE SEED

Called the "Sky Hook," new container tested by ATSC for air delivery of emergency supplies features airfoil arm which spirals it vertically to earth, enabling more accuracy than drop by parachute. Blade, approximately 1 ft. by 3 ft., is flat wooden frame covered with airplane cloth. Speed of descent is 35 ft. per second. Bulbous plastic container holds 65 lb. of supplies, might carry mail in postwar use. (ATSC photo)

Now...

Aerodynamic Braking by REVERSE THRUST

Aerodynamic braking, another first by Curtiss, brings to the science of flight a new and significant development. The propeller, long the source of forward thrust in aircraft, now provides thrust in reverse to reduce the landing roll of the airplane smoothly and surely, regardless of ground friction. Aerodynamic braking, like many other features, is inherent in the versatile Curtiss design.

Features of Aerodynamic Braking

1. Shorter landing roll
2. Greater safety of dual braking system
3. Smoother deceleration
4. Greater safety on slippery runways
5. Shorter taxi time
6. Unassisted ground handling
7. Reduced tire and brake wear
8. Lighter brake system possible

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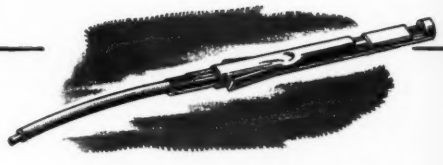
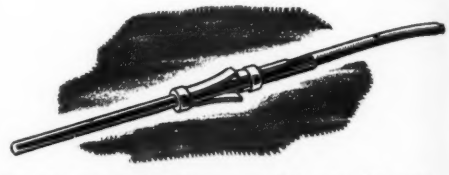
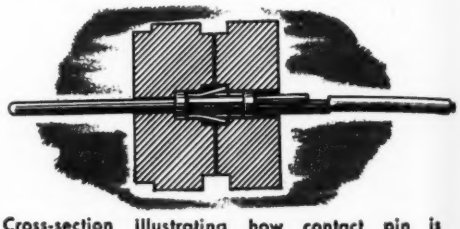


Socket construction features spring-loaded contact for positive electrical connection with pin.



Both pin and socket feature spring snap for ease of assembly in housing insulators after soldering.



Cross-section illustrating how contact pin is snapped into place after soldering on lead wires.

Breeze BREEZE NEWARK

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British Voice Worries On Postwar "Go-Aheads"

. . . Look to air parley for clarification . . . "Spits" continuing.

Virtually on the eve of the 55-country air parley scheduled to open in America Nov. 1, British air officials stated that England was first in the field and was resolved to stay there, the reference being to the question of Britain's postwar air transport position.

Lord Brabazon, whose committee proposed a number of postwar aircraft all now termed obsolete in concept, contended in return that the United States was determined to keep the upperhand and that therefore U. S. plants had been given the go-ahead on new airliners. (Such a development, however, has not been confirmed in America.)

In contrast, said Lord Brabazon, British airline operators are not getting even the promise of a machine of the right quality, and British factories have been stopped from developing any new types.

Look to Air Parley For Clarification

British belief that the U. S. is jumping the gun on postwar aircraft construction appears to have been nurtured by prolific American announcements regarding new "super" airliners. Further, the recent demands by some members of Congress that the U. S. should take over various bases throughout the world have broadened British apprehensions over America's postwar air aims.

Right-thinking persons on both sides are hoping that the new parley will clarify the many questions and alleviate suspicions arising from the various semi-official announcements.

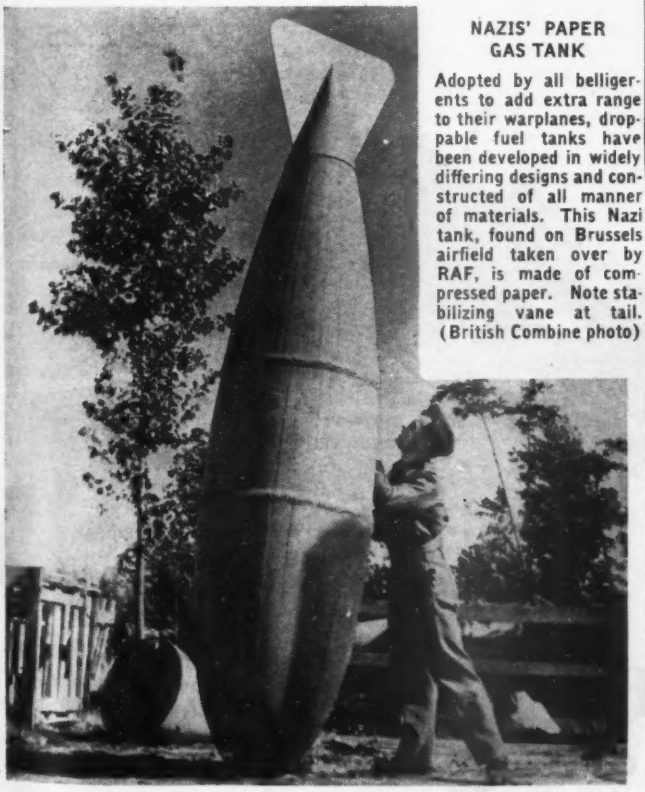
"Spits" Continuing

It is stated that production is continuing on the Spitfire, though the last of the more than 10,000 Hurricanes (pictured page 237, Oct. Aviation) has now been turned out. The latter craft is being replaced by faster Typhoons and Tempests. (For photo of latest Spitfire — Mark XIV, powered by 12-cyl. Griffon engine and turning 5-blade prop—see page 223, Oct. Aviation.)

★INTERNATIONAL BRIEFS★

Netherlands Air Force has been made an independent organization (preparatory to the return to the homeland) under the command of Rear Adm. J. W. Termytelen.

New Zealand has discontinued sending its cadets to Canada for training in the Empire Air Training Program. It will now handle all trainees at home.



NAZIS' PAPER GAS TANK

Adopted by all belligerents to add extra range to their warplanes, droppable fuel tanks have been developed in widely differing designs and constructed of all manner of materials. This Nazi tank, found on Brussels airfield taken over by RAF, is made of compressed paper. Note stabilizing vane at tail. (British Combine photo)

WORLDATA . . . . . By "VISTA"

Further details have been received on the new air route which the Qantas Empire Airways has been operating across the Indian Ocean from Australia to India. Known as the Indian Ocean Service, the line has been flown since June 1943 with Catalinas. Involving a non-stop flight of 3,563 mi., the distance admittedly is the longest regularly scheduled hop in the world. It's covered in around 27 hr. by the "Cats," which take off with a gross weight of some 35,000 lb., including 16,000 lb. of fuel. They are equipped to carry three passengers and 500 lb. of mail and freight.

Passengers who have made the trip are initiated into the "Rare and Secret Order of the Double Sunrise" to remind them of the more than day-long flight. A landplane service is to be inaugurated with a four-engine type plane to be known as the "Kangaroo". Longest hop with this land craft will be 3,156 mi.

Some commercial airlines in Europe have started operating again, after a 4½-yr. lull, getting the jump on pessimists who foresaw endless delays. The British are operating between London and Paris; Air France has reopened its routes from Paris to London, Algiers, and Tunis, besides a connection between Bordeau and Marseilles; and an airline presumed to be British has started regular services between Rome and Lisbon via Gibraltar.

Further information on the Conference of International Air Traffic Operators (June Aviation) indicates that this CIATO is the brainchild of old IATA members. It was formed when meetings to discuss postwar problems could not be held legally under IATA auspices. While the conference still has not received the support of countries with major airlines, such as England, America, and Holland, its aim appears of great value in rejoining the scattered and demoralized smaller international airline operators.

Resolutions adopted at the first general CIATO meeting: 1. That civil airline operators shall resume their activities as soon as possible after the end of hostilities, without prejudice to continuance of air transport command type operations. 2. That these operators should be enabled to obtain transports sufficient to bring their fleet to prewar levels. And 3. That the United Nations should set up a committee, with the airline operators represented, to deal with question of making such craft available.

Criticism has appeared in English trade magazines concerning American aircraft publicity, argument being to the effect that the releases claim everything turned out is the "fastest, biggest, and bestest in the world".

Britain's Gloucester jet-propelled fighter (pictured on page 213, Oct. Aviation) now is stated to be in full production. Reportedly it is better than the German jet craft.

Avro has petitioned the British Air Ministry for permission to start building the prototype of its 125-passenger airliner.

The Japs state they have put a new wooden bomber into service production, and they claim that it surpasses the British Mosquito.

French patriots are said to have saved several of the huge six-engine flying boats built in Vichy France. Their hope is that they may be used to start an early trans-Atlantic service.

BOAC is now operating 140 aircraft, a 30 percent increase over the 109 which were in service in Jan. 1943.

Two new German planes are reported by Britain's magazine, "The Aeroplane," both rumored to have been specially designed to take Hitler to Japan. They are the He-178 and the six-engine Ju-390.

And Britain's magazine "Flight" reports that the Boeing Fortress Fighter, earlier mentioned by the Nazis, is known as the B-40 and has 28 50-cal. machine guns and two 20-mm. cannon.

Captain Johnson, American ace, has shot down several of the new German Me-209 fighters, which are equipped with a 12-cylinder in-line engine, a 30-mm. cannon, and two 13-mm. machine guns.

Bolivia has fined the German Lufthansa for smuggling 250 lb. of cocaine to Germany.

Photo of a Barracuda taking off from a British carrier shows an accelerator gear carriage (running along slot in flight-deck) on which plane's left main wheel rides during takeoff.

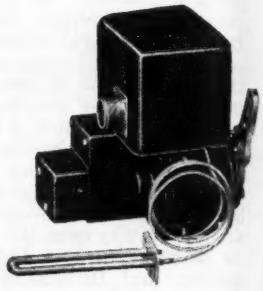
AUTOMATIC MODULATION

by WHITE-RODGERS

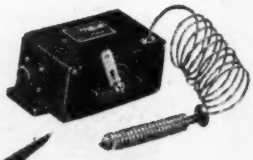
White-Rodgers modulating temperature controls and Servo Actuators provide the safety of automatic local or remote control and assure greater freedom for the pilot in applications involving the control of:

Cabin Temperature
Anti-Ice Temperature
Carburetor Air Temperature
Carburetor Mixture
Carburetor Throttle

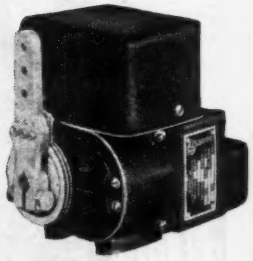
Authorized manufacturers concerned with the above or similar applications may secure engineering data on request.



● Compact temperature controlled actuator especially adapted for anti-ice applications. Arm rotation adjustable within range of 30 to 120 degrees. Torque output up to 75 inch-pounds.



● Modulating temperature control used for regulating carburetor air temperature.



● Servos available in several types for applications involving additional power requirements.

WHITE-RODGERS ELECTRIC CO.
SAINT LOUIS

Mid-Continent Airlines has terminated its Army air cargo route contract in the Middle West. Net profits for the seven months ended July 31 were $123,056 against $103,744 in the like 1943 period.

Air Associates reports that a renegotiation agreement recently executed on operations for the fiscal year ended Sept. 30, 1943 reduced net profits after taxes by $552,902. Revised net income for the period is $582,648 or $4.32 a share. This compares with net income of $448,401 or $3.32 a share, in the preceding year.

Republic Aircraft owns inventory materials valued at well under $500,000, despite sales of $220,000,000 in the first half of 1944, according to company officials.

Northwest Airlines reports net earnings of $517,789 or $1.45 a share for the year ended June 30 compared with net earnings of $300,092 or $1.28 a share in the previous year. A postwar reserve of $100,000 was set aside from 1944 earnings, according to Pres. Croil Hunter.

Liberty Aircraft stockholders have approved a two-for-one split in the common stock. The company also is issuing 80,000 shares of $1.25 convertible preferred stock of $20 par value and will apply part of the proceeds to retirement of a $1,000,000 bank loan. It is also planned to acquire all or part of the plant facilities now under lease from a government agency. Unfilled orders on July 31 were $13,200,000. Sales for the nine months ended Aug. 31 were $16,600,000 against $14,600,000 in the like 1943 period.

Dividends: Northrop Aircraft has declared two dividends of 25c. each on the A and B stocks payable Oct. 17 and Jan. 1, 1945. This represents initial payments on the Northrop stocks. . . . McDonnell Aircraft Corp. paid a $1.50 preferred dividend in October. . . . Lockheed Aircraft declared a 50c. dividend in September, while Beech Aircraft paid a $1 dividend on Oct. 26.

The Aviation Corp. reports net income of $3,199,871 or 49c a share for the nine months ended Aug. 31 against net income of $2,810,486 or 15c a share in the like 1943 period. Earnings are subject to final renegotiation settlement.

Ex-Cell-O Corp. has acquired 93,972 shares of the Fuel Injection Corp. at 40c. a share. The latter company has 100,000 shares outstanding, and it is the intention of Ex-Cell-O to purchase the remaining shares.

Lockheed Aircraft Corp. has negotiated a loan of $175,000,000 with 15 large commercial banks, according to C. A. Barker, Jr., treasurer. The loan, described as a V credit, was arranged to meet current operating expenses and termination needs. Last year the company increased its line of credit with the banks from $60,000,000 up to $105,000,000. Other large credits negotiated by the industry include one of $200,000,000 by Consolidated Vultee Aircraft Corp. and one of $125,000,000 by Sperry Corp.

North American Aviation, last of the big aircraft concerns to issue its year report, had net earnings of $6,790,323 or $1.98 a share for the fiscal year ended Sept. 30, 1943 as compared with net earnings of $7,370,626 or $2.15 a share in the preceding year. Sales were $509,139,600 against $253,226,100 the year before. Earnings for 1943 were reduced by $11,328,000 through an agreement reached with the Price Adjustment Board. A sum of $5,000,000 was charged off to contingencies, compared with $1,530,000 the previous year.

Grumman Aircraft does not plan a split-up in its capital shares, company officials say, despite the persistent Wall Street rumor that something of that nature is brewing. The increase in authorized capitalization from 600,000 shares to 3,000,000 shares approved by stockholders earlier this year was for the purpose of providing more working capital when, as, and if needed.

Piper Aircraft declared an initial common dividend of 12½c a share payable Oct. 25. The company, whose stock has recently been listed on the N. Y. Curb Exchange, produced around 2,250 planes in the year ended Sept. 30 besides non-aircraft products for the Signal Corps. Unfilled orders included 1,832 planes for the government.

Aircraft Accessories Corp. reports net earnings for the year ended Apr. 30 of $1,172,247 or $1.64 a share against $741,433 or $1.21 a share in the like 1943 period. Sales were $38,758,829 against $24,972,460.

Ryan Aeronautical Corp. reports a renegotiation settlement for the year ended Oct. 31, 1943 whereby $73,000, after tax credits were deducted, was refunded to the government. The $73,000 has been charged to a contingency reserve provided for the purpose, according to Pres. T. Claude Ryan.

All American Aviation reports net income of $238,587 or 78c. a share for the year ended June 30 against net income of $27,689 or 11c. a share in the preceding year. Pres. Halsey R. Bazley told stockholders that negotiations are under way with both domestic and foreign airlines for use of the company's air pickup equipment.

ADDING IT UP.....By RAY HOADLEY

Termination loans. Bankers report that war contractors are in no hurry to apply for the new T-loans now available. One reason is that the government is settling terminated contracts somewhat more rapidly than it did a few months ago. Another reason is that the T-loan procedure is so simple and workable that contractors feel that they are safe in watching developments a little longer before making any advance commitments for such loans. The Federal Reserve Bank, however, has warned banks to be prepared to make large numbers of these loans within a few weeks after V-E Day.

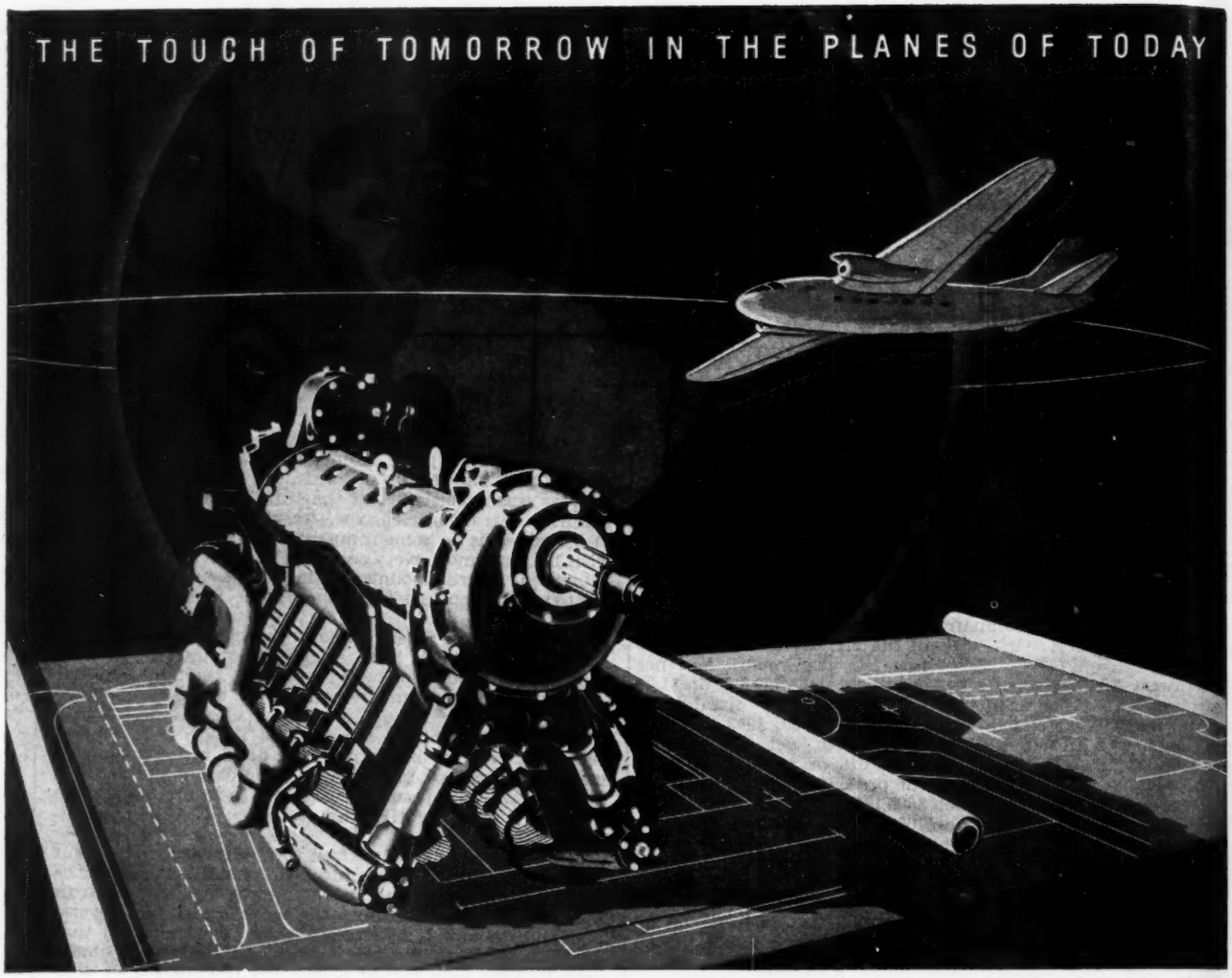
Airline Earnings. The improvement in domestic airline profits that showed up towards the end of the second quarter was accelerated in the third quarter to such an extent that trade circles expect results for the year will be at record levels for some companies and compare favorably with 1943 in almost every case. The airlines still need more equipment as cross country traffic increases in proportion to stepped-up operations in the Pacific theater.

Financing. Wall Street bankers expect that some of the 28 companies which have evidenced an interest in personal plane production will be seeking additional capital in the near future to finance production of the new models they hope to put on the market as soon as possible. It will be the first bit of financing of this type in several years, but bankers expect it will be done in the customary method of issuing new stock. The small manufacturer, however, will find it somewhat easier to secure bank loans than he did before the war.

Stock Market. Publicity given to recent large equipment orders by several airlines proved the spark that set off the long delayed rise in the aircraft stocks. And the big volume buying that came into the market and shot several issues up to new high levels for the year indicated that all Wall Street had suddenly realized that these stocks actually have been selling at only slightly more than their net working capital per share. Yet with all this new buying the aircraft stocks were selling at less than 60 percent of their highest price in 1938. The funny thing about it is that after five years of huge war demand for planes, prices begin to rise just as the companies begin to get sizable cutbacks.

Tax Plans. Nearly all the postwar tax plans that we have scanned provide considerable relief to corporate stockholders, either through abolishment of excess profits taxes or credits to a company or its stockholders for dividends paid out. It appears that a definite pattern for early relief to aviation stockholders will emerge from all these suggestions.

Transfer of materials. Industry officials feel that marked progress was made towards orderly reconversion in the aircraft industry when the Treasury Department, after long hesitation, gave its okay to the plan whereby company-owned excess materials can be sold to the government at $1 and inventory losses entered for tax purposes. It's the first real break the industry has got from the tax people in a long time, and it will mean substantial savings to the manufacturers if they can register their inventory losses in a year of really good earning power such as 1944.



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Clean cut and durable as a gem, Ranger engines deliver their dynamic punch under the toughest year-'round flying assignment in the book.

Normally, engines in service are "pulled" for major overhaul after 600 hours. But Rangers have consistently paid a service "bonus" up to 50 per cent. It's common for a Ranger engine to reach the *900-hour* check point, purring sweetly, delivering full power . . . 30,000 and more *extra* miles of flight.

Ranger-powered planes cut through the rugged cold of Canada, the dust-laden heat of deserts; they fly in Mexico, throughout South America—and in South Africa. They do their flight job, sturdily, under all sorts of field conditions.

The twelve cylinder Ranger, for example—aircooled for weight economy, inverted for a better field of vision, inline for better streamlining—logs hours and hours of time in rigorous wartime operations. Yet Rangers continue to pay a bonus—hundreds and hundreds of *extra* hours in the air.

In use only on military planes today, Ranger engines on commercial airline and private planes tomorrow will provide those extra hours of service for efficient and economical operation.

Fairchild research—the constant quest for better materials, better methods, better results—has made this Ranger bonus possible. It springs from Fairchild engineering knowledge and experience that lends the "touch of tomorrow to the planes of today".

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RANGER AIRCRAFT ENGINES

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Aviation People

JOHN C. LEE, former manager of the Aircraft War Production Council, West Coast, has been elected president of Menasco Mfg. Co., succeeding John E. Royal, who has resigned due to ill health. A major producer of hydraulic landing gear struts, Menasco builds for P-38's, '47's, and '51's. (Harris & Ewing photo)

A. G. KINSMAN, for some years head of Northwest Airlines' passenger traffic department, has been named to new administrative position of western traffic manager, with headquarters in Seattle, as part of NWA's program of development of Pacific Northwest as air transportation gateway to Alaska and the Orient.

GEORGE R. ACHESON, commanding officer of a heavy bombardment wing in Italy, has been advanced from colonel to brigadier general. He began his Army career as a private 19 yr. ago, serving as mechanic at France Field, Panama, before returning to the U. S. for flight training which led to commission in 1927.

WILLIAM A. MARA, former director of personal aircraft sales for Convair, has joined Bendix Aviation Corp. as staff executive to supervise and coordinate Bendix product developments concerned with personal planes. Mara helped late Eddie Stinson organize his company in 1925 and then concentrated on sales.

A. A. KUCHER, director of research of Bendix Aviation Corp. and chairman of its long-range planning committee, has been named company vice-president. In aircraft engineering work during World War I, he later was associated with Westinghouse and General Motors, leaving latter in 1942 to join Bendix.

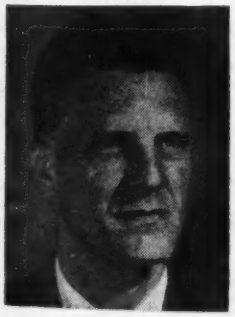
RALPH WALL has been named assistant sales manager of Pacific Div., Bendix Aviation Corp. A member of Division's sales department for past six months as liaison sales engineer, he now assumes charge of all current military sales. He formerly was with Lyon Metal Products.

MYRON B. GORDON, formerly vice-president and general manager of Wright Aeronautical Corp. and a vice-president of Curtiss-Wright, has been elected a director and vice-president in charge of operations for Fairchild Engine & Airplane Corp. He had been Wright's v.-p. and g.m. since 1935.

J. HOWARD BLAKE has joined Glenn L. Martin as director of market research for non-aeronautical divisions to coordinate commercial development of that company's projects outside aviation field. Prior to joining Martin he had been engaged in market research for N. W. Ayer & Son.

CLARENCE L. RIEGAL has been elected secretary and assistant treasurer of Luscombe Airplane Corp., Trenton, N. J. Prior to joining Luscombe he had been assistant district auditor for General Electric in New York and headed N. Y. Credit Men's Assn. (Affiliated Photo-Conway)

JOHN M. BEARDSLEE has been appointed manager of CAA's new 9th Region in Hawaii, where he will direct some 200 CAA employees. For past year he has been chief of Airways Engineering Branch of 6th Region, headquartering in Santa Monica. Earlier he served in Alaska. (CAA photo)



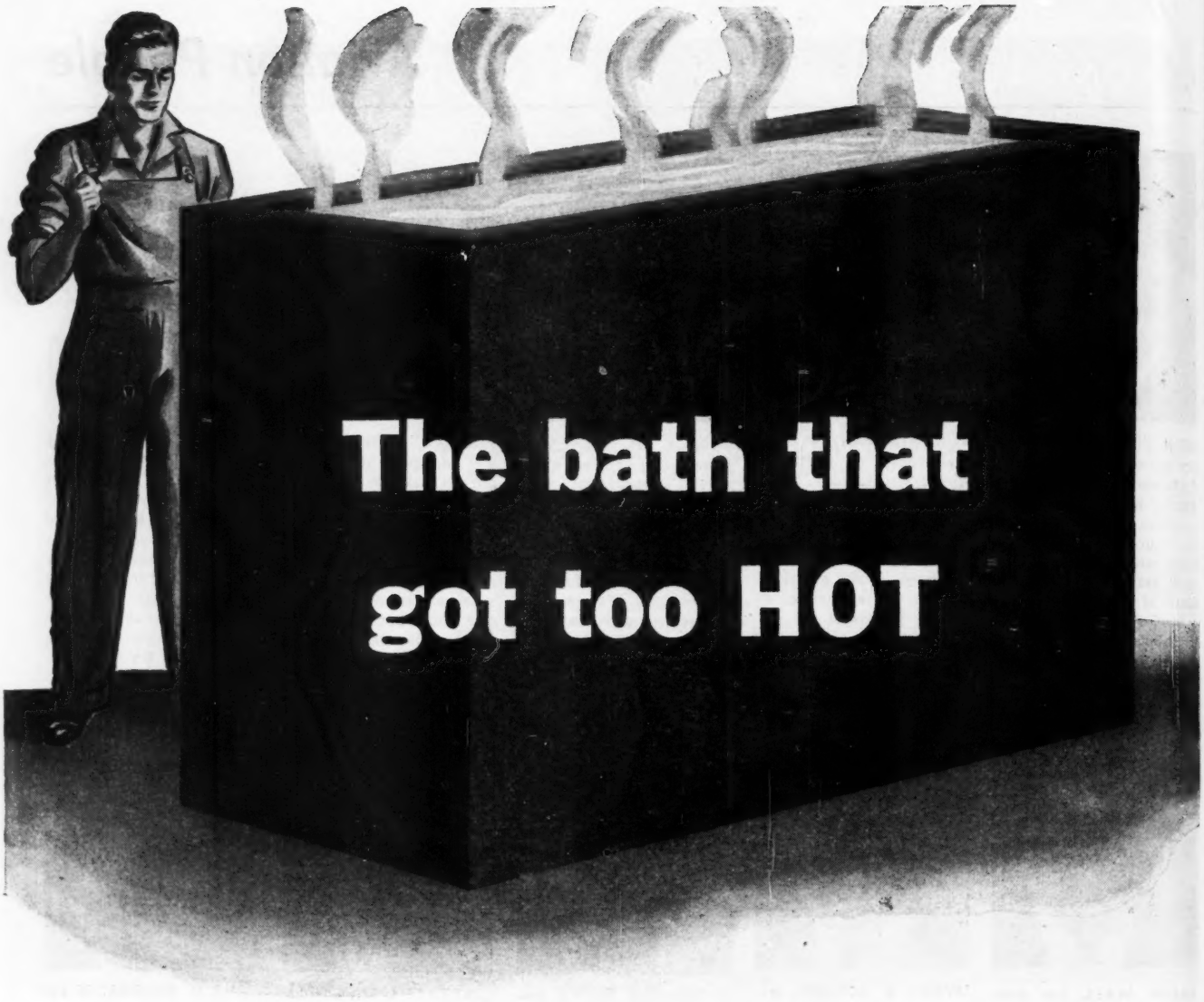
JOEL WHITNEY, director and manager of the Ryan Aeronautical Institute, has been named chairman of San Diego section of Institute of Aeronautical Sciences, succeeding Ernest G. Stout of Convair, who is now out of country on a special mission. Whitney was formerly vice-chairman of local chapter.

CAPT. ROBERT SAILORS, UAL pilot flying ATC Alaska runs, set record of 6 hr. 43 min. between Anchorage and Seattle, then followed with record of 7 hr. 15 min. for Anchorage-Portland run with hospital cases being evacuated from Alaskan area. Both runs were non-stop flights made in Douglas C-47. (UAL photo)

LEONARD J. POVEY, former vice-president in charge of flight operations for the Embry-Riddle School of Aviation, has taken a military training liaison position with Fairchild Aircraft Div. at Hagerstown, Md. Povey went to Cuba in 1934 to organize Cuban Air Force, personally training most of early pilots.

LAURENCE E. COONEY has been appointed vice-president and general sales manager of The Austin Co. With the firm since 1919, when he was assistant to general construction manager, he was project engineer on Bell Aircraft's construction from 1941 to '43, then Cleveland district sales manager.

HENRY E. MOOBERRY has been named assistant to the president of United Aircraft Corp., headquartering at United's East Hartford offices. He joined company's public relations staff in '42, following 11 yr. with the AP, and was made assistant director of advertising and publicity a year ago. (John Haley photo)



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Side Slips

READING CHET RICKER'S STORY on the Nazi buzz bomb (page 190) brought to mind the work of our own inventors some 25 yr. ago. After a year and a half of experimenting on a flying bomb, everything was set for the trial flight, which was to parallel a line of our destroyers out in the Atlantic. The buzz bomb was to carry 5 gal. of fuel so that it would hit the ocean somewhere this side of the last destroyer but, through a slip in orders, it was gassed to capacity. Last report from the furthermost destroyer was this laconic radio message: "At proper altitude, on course, disappearing over horizon." Nobody ever will know how big a splash it made.

• Very official-looking sign posted prominently in an Officers' Club: "In case of air raid stand near slot machines, the jackpot hasn't been hit yet."

• At the recent American Helicopter Society meeting the renowned Igor Sikorsky reported how, some time ago, he had shown some movies of his helicopter to United's Board Chairman Rentschler, who was duly impressed. As the lights came up, Mr. R. said somewhat facetiously: "Igor, I have seen your machine hover, fly to the right, fly to the left, and fly backward. Now how about showing us some views of it going forward." To which the irrepressible Mr. S. replied, "I am sorry, Mr. Rentschler, that is one problem we have not solved yet."

• Discussing helicopters the other day with a veteran test pilot, we asked if he'd flown a certain job. "Oh yes," he replied, "as a matter of fact I set an altitude record for it. I'd been hovering just off the ground, feeling out the controls when, somehow, it got out of the ground cushion air and *pffft*, I suddenly found myself up between 60 and 70 ft.—and plenty scared, too.

• We asked this same pilot what contribution he thought had been made by a new type 'copter which recently completed its maiden flights. "One thing," he said, "at least—by flying it has proved something we've all been looking down our noses at for a long time."

• Golf widows have been with us for some time, but we just heard of our first airplane widower. Seems a couple on the Atlantic seaboard had lived in perfect marital bliss for some years—until the war brought a Navy patrol base nearby. Under certain winds the pilots had to take their heavily laden PBM's off right over the couple's house. Anyhow, it drove the Mrs. mad. She swore they practically scraped paint off the roof, and though also swearing undying love for hubby, she packed up and went home to mother "till they're gone." We think the story will have a happy ending, for scuttlebutt says the squadron is about to be transferred. Hubby's got his fingers crossed, but tight.

• Back in the days when practically every personal airplane was designed around the OX-5, the dwindling supply of this type engine gave an operator quite an idea, one by which he thought he might well corner the market on the remaining new OX-5's. He was selling quite a few airplanes, by those days' standards, and he made a practice of taking fly-away delivery on all of them. At the end of the first day's flight away from the factory he always landed at an isolated pasture, where he'd be met by a cohort with a truck. During the night they'd take out the new engine, put in a re-conditioned job, and then next morning he'd fly on to deliver an all "new" plane. By the time he got caught he had himself a really good supply of new OX-5's, but he never was quite able to corner the market. Although out of jail now he's reported to have no interest whatsoever in the post-war personal plane distribution field.

• Good friend of ours who's spent the last year or so pushing young soldiers through a concentrated propeller-servicing course reports he was almost whipped not long ago. Seems one young soldier was a whizz of a natural mechanic—anything he could do with his hands he did superlatively. But the mathematics of subtracting degrees for pitch setting just wouldn't sink into his brain; for some reason his mind drew a blank on it. Finally, in desperation, the instructor said, "If I had $27.43 and gave you $19.52, how much would I have left?" Quick as a flash came the answer, "That'd be $7.91," and with it the solution to their problem. "Now," says the instructor, "I'd fly behind any prop that kid had serviced."

"Back in '40, Maguire's engineers gave him an expandable plant, but they didn't give him any termination-contraction plans."

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ENGINEERING DATA

Tube Bursting Pressures.....1

Bursting Pressures of Seamless Steel Tubing is title of new bulletin issued by Globe Steel Tubes Co., Milwaukee, described as reference chart for engineers. Tubing from ⅛ to 9⅝ in. o.d. is covered.

Spring Design 2

Muehlhausen Spring Corp., Logansport, Ind., offers booklet, *Springs Designed For the Job Improve Product Performance.* Described are four factors essential to correct spring design; illustrated are five basic types with wide variety of shapes and sizes; and covered in detail are twelve commonly used spring materials.

Vinyl Chloride Latex.....3

Bulletin descriptive of "Geon" latex, a colloidal dispersion of vinyl chloride types of polymers in water, is offered by Chemical Div., B. F. Goodrich Co., Akron. Nature, stability, physical properties, and compounding of product are discussed.

Universal Joints 4

The Gear Grinding Machine Co., Detroit, offers technical bulletin on "Rzeppa" universal joints, stated to be designed on new mechanical principle.

Pressure Tubes 5

Bulletin from Revere Co., Wallingford, Conn., describes pitot-static, static, total pitot pressure tubes, and static-pitot thermocouples and their installation.

Aluminum Alloy 6

In publication, *Aluminum Progress*, (Vol. 1, No. 2) Reynolds Metals Co., Louisville, describes R-301, new aluminum alloy for use in aircraft, that is stated to have greater strength, permitting structural members to be of lighter gage.

Vulcanized Fiber 7

Engineering data on phenol and vulcanized fiber is given in bulletin offered by N. S. Baer Co., Hillside, N. J. Listed are standard grades, and electrical properties, mechanical strength, and moisture absorption are detailed.

Powder Metallurgy 8

Chrysler Corp's. Amplex Div., Detroit, announces new commercial powder metallurgy catalog containing information on engineering developments and general data. Listed are more than 13,000 available sizes of bearings and cored and bar stock sizes, and such subjects as specifications, design features and practice, shaft clearance, load rating charts, recommended methods of sizing, and tolerance data are covered, along with drawings and tables on chamfers and fillets, easy machining methods, and data on lubrication.

Locking System Catalog.....9

Bardwell & McAllister, Hollywood, Calif., has published new catalog on Rosan locking system for threaded inserts and studs, with specifications and installation procedure.

Propeller 10

Iso-Rev automatic constant-speed propeller for light and medium powered aircraft that uses V-belt on split-pulleys principle, is described in new booklet issued by Zimmer-Thompson Corp., Long Island City, N. Y.

Cellulose Motion Picture.....11

Hercules Powder Co.'s Cellulose Products Dept., Wilmington, Del., offers new film, *Careers for Cellulose*, that traces story of cellulose from cotton fields through Hercules plants to testing laboratories and manufacturing plants. Technical details are shown.

Paper Industry 12

Industrial Papers—The New Production Answer, booklet from Central Paper Co., Muskegon, Mich., describes use of paper as a flexible and versatile material capable of improving products while reducing costs and as a substitute for scarce materials. Quick index lists 68 industrial papers.

Metallizing Process 13

Folder descriptive of "Metcolizing," processes for prevention of corrosion of iron and steel at high temperatures, is offered by Metallizing Engineering Co., Long Island City, N. Y.

Retaining Rings 14

Booklet containing engineering data for external and internal types of Waldes "Truarc" retaining rings is offered by Weldes Koh-I-Noor, Inc., Long Island City, N. Y. Included are specifications and dimensions for rings from 0.125 to 10-in. shaft dia., also thickness and groove dimensions.

PRODUCTION

Infra-Red Process 15

Near infra-red radiant heat process is described in new illustrated brochure issued by Wabash Appliance Corp., Brooklyn.

Heat Resistant Coatings.....16

Resistance to heat, corrosion, and oxidation through use of "White Hot" and "Pyro-Chrome," protective coatings, is described in bulletin from Preferred Utilities Mfg. Corp., New York. Application is to refractories, metals, and ceramics.

Tool Maintenance 17

Frederick L. Woodcock (chief engineer, Hamilton Standard Propellers Div., United Anrcraft, Hartford, Conn.) has written an article titled *Extending the Life of Tools and Gages*, describing the brazing process of repairing, using low-temperature silver alloy. Copies are available from Handy & Harman, New York City.

Drill Pointing 18

Correct procedure for pointing drills is given in booklet, *Correct Drill Pointing*, issued by Chicago-Latrobe Twist Drill Works, Chicago. It also contains table of cutting speeds.

Sealers and Cements 19

Dolphin Paint & Varnish Co., Toledo, announces new catalog on its products—air and dust sealers, cements, glazing compounds, rustproofers, and cold resisting putties.

Packaging Materials 20

Sherman Paper Products Corp., Newton Upper Falls, Mass., offers revised manual on packaging materials, with emphasis on protection of war materials. Digest of government specifications and expanded section on protection of metal products is included.

Precision Grinding 21

Use of straight oil for precision grinding is described in booklet, *Grinding With Oil*, issued by D. A. Stuart Oil Co., Chi-

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AVIATION, 330 W. 42nd St., New York City 18

NOVEMBER 1944

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31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57									
NEW PRODUCTS:					58	59	60	61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
107	108	109															

NAME ..... TITLE.....

FIRM OR AFFILIATION.....

ADDRESS .....

In the Field of

RADIO NOISE ELIMINATION,

Tobe is the Acknowledged Leader!

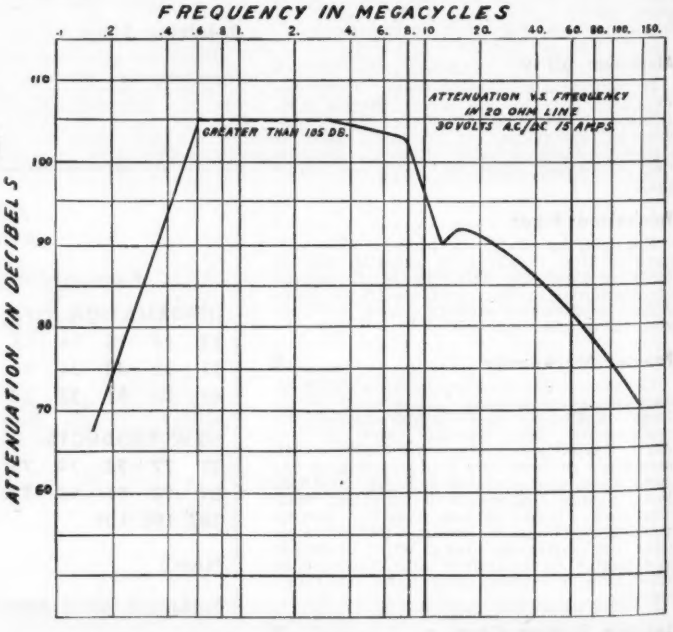
ONE engineering result of the war is increased knowledge of radio interference problems. It will never be lightly treated again. No engineer can tackle the development of an electrical design without giving due consideration to minimizing the radio interference it creates in operation. Specially designed filters, to be built into electrical circuits, can usually solve the problem of radio interference.

Here at Tobe is a great storehouse of knowledge in this subject. It is *sound* knowledge, gained by the most intense interest and experience of any company in the field.

Tobe Filterizing is a copyrighted term. It means that Tobe knows how to "filterize" man-made radio noise. Why not make use of this valuable 16 years' of experience in your own engineering? Place your reliance on Tobe and the famous Tobe Filterettes. Send us your problems now.

CONTAINER DIMENSIONS

Length . . 3 1/16"
Width . . 2 1/8"
Height . . 2 7/8"
Overall length 5 7/32"


FREQUENCY IN MEGACYCLES
.1 .2 .4 .6 .8 1. 2. 4. 6. 8. 10 20. 40. 60. 80. 100. 150.
ATTENUATION IN DECIBELS
110 100 90 80 70 60
ATTENUATION VS. FREQUENCY IN 20 OHM LINE 30 VOLTS A.C./D.C. 15 AMPS.
GREATER THAN 105 DB.

LONG LIFE ASSURED!

TOBE DEUTSCHMANN CORP.
CANTON, MASS.

SUPPRESS MAN-MADE RADIO STATIC
TOBE
FILTERIZED

A SMALL PART IN VICTORY TODAY — A BIG PART IN INDUSTRY TOMORROW

cago. Featured is chart comparing wheel markings of several of the larger grinding wheel manufacturers.

Welding Mild Steel.....22

New method stated to increase speed in the welding of mild steel—"Fleet-Welding"—is described in booklet from Lincoln Electric Co., Cleveland. Among subjects covered are: Use of "arc force" to increase speed; effect of penetration on costs; factors effecting speed; and information on use of procedure tables.

Welding Symbols Chart.....23

Hobart Bros. Co., Troy, Ohio, offers new wall chart illustrating basic characters of welding symbols recommended as standard by American Welding Society. Graphical language of industry is illustrated separately for fusion welding, resistance welding, and for combination of both.

Scheduling System 24

Machine Load Control, bulletin from Remington Rand, Inc., Buffalo, describes equipment and procedures connected with the "Sched-U-Graph" scheduling system, stated to have been recently improved.

MACHINERY & ACCESSORIES

Care of Micrometers 25

Designed to introduce company's master setting and checking rolls for micrometers and other precision measuring instruments, *The Use and Care of Micrometers*, booklet from Sav-Way Industries, Detroit, describes functions of parts and tells how to use and care for micrometers. "Do and don't" list is included.

Soft Metal Melting.....26

Surface Combustion Co., Toledo, has published bulletin, *Soft Metal Melting With Surface Combustion Furnaces*, describing equipment and giving properties of soft metals.

Counterbores and Cutters.....27

Moreland Tool Co., Detroit, has published new catalog on counter-bores and special high speed steel cutting tools, including carbide-tipped tools.

Rotary Shear Attachments.....28

Bulletin No. QW-120 from Whiting Corp., Harvey, Ill., features applications and operation of attachments for rotary shears. Attachments are designed for effective handling of circle cutting, splitting, joggling, and flanging.

Fluid Motors 29

Sundstrand Machine Tool Co., Rockford, Ill., offers bulletin, *Oil Power Fluid Motors*, describing operating principles, features, applications, and engineering data on these units.

Inspection Equipment 30

Barco Scraping Co., Cleveland, has issued bulletin describing surface plates, angle irons, and straight edges made of "Meehanite."

Surface Inspection 31

New process of surface inspection is described in bulletin from Rex D. McGill, Cleveland. Employed is plastic film, one side of which is softened by use of solvent, after which a contact replica of surface is made. Mounted in cardboard frame and projected, image can be enlarged 100 diameters, and all contours are shown in three dimensions. Process called "Faxfilm," is described as speedy, inexpensive, and accurate.

Broaching Machines 32

Colonial Broach Co., Detroit, announces bulletin descriptive of its line of pull-up broaching machines, tools, and attachments.

Milling Machine 33

The Miller That Uses Its Head is the title of booklet from W. H. Nichols & Sons, Waltham, Mass., describing processes and practices in use of milling machines.

Pressure Unit 34

Mechanics Engineering Co., Jackson, Mich., offers circular describing "Bar-Lok" quick-acting pressure unit designed for medium and heavy duty. It is stated to give speedy adjustment and firm holding in jig and fixture work and in machine, assembly, and also welding operations.

Belt Polishing Machine.....35

Circular describing VM-DBX abrasive belt polishing machine has been issued by Divine Bros. Co., Utica, N. Y. Sizes and specifications are given.

External Indicating Gages.....36

Described in new folder are external indicating gages made by Metrical Laboratories, Ann Arbor, Mich. Emphasis is placed on use of indicating rings of snap gage type, stated to make readings as close as .000025 in. possible.

Cutters 37

New catalog on cutters, router bits, heads, and machines has been published by Ekstrom, Carlson & Co., Rockford, Ill. Sizes, specifications, and hints on applications are given.

All-Around Loader.....38

Universal loader, designed for use as platform loader, lifting rack, material bucket, crane, bulldozer, and having many other applications to heavy work, is described in circular from maker, Lull Mfg. Co., Minneapolis.

Flat-Spray Nozzles 39

Folder descriptive of "Rex" flat-spray nozzles and their uses where water is used in cleaning, cooling, and washing operations, has been received from manufacturer, Chain Belt Co., Milwaukee. Tabulated information on their discharge in gpm., their dimensions, and list of materials and sizes are given.

Surface Grinders 40

Engineering data on surface grinders is offered by Ampco Metal, Milwaukee, in Bulletin No. 126.

Reduction Units 41

"Speedaire" fan-cooled worm-gear reduction unit is described in bulletin offered by Cleveland Worm & Gear Co., Cleveland.

Metal Piercing 42

Wiedemann Machine Co., Philadelphia, has issued bulletin describing method of super-speed piercing of sheet metal through templates by R-34 turret punch press.

ELECTRICAL

High Frequency Cable.....43

Circular from Federal Telephone & Radio Corp., Newark, N. J., gives impedance nomographs on its "Intelin" coaxial cable.

Spark Plug Connectors 44

"Contact" shielded sparkplug connectors, made by Menaugh-Dutterer Co., Chicago, are illustrated and described in new company bulletin just issued.

Ceramic Wire Insulation.....45

Sprague Electric Co., North Adams, Mass., announces new ceramic-coating wire insulation, "Ceroc 200," stated to withstand 200 deg. C. continuous operating temperatures.

Noise-Suppression Capacitor 46

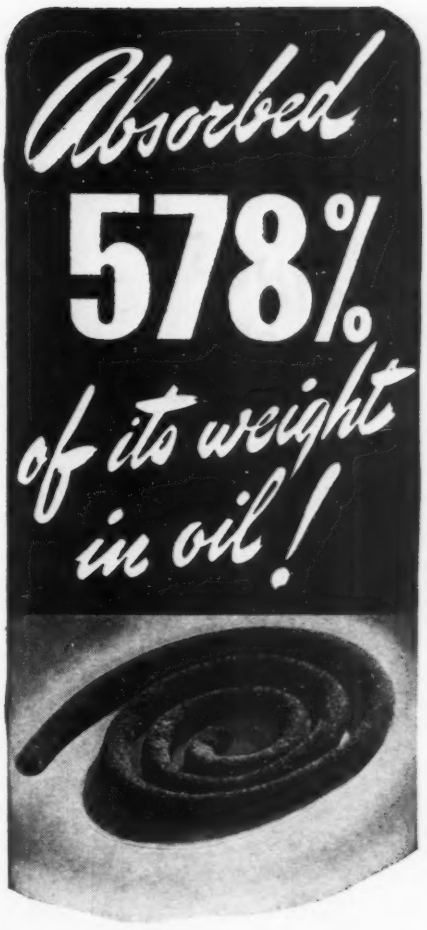
Bulletin GEA-4308, from General Electric Co., Schenectady, describes new "Pyranol" radio-noise-suppression capacitor, specially designed to reduce radio-noise from generators, inverters, motors, and other sources.

Electronic Book Guide.....47

Guide to literature on radio and electronics is offered by Allied Radio Corp., Chicago. Listings are both by subjects and by publishers.

Aircraft Controls 48

Lear, Inc., Piqua, Ohio, offers reprints of paper, *The Key to Modern Aircraft Controls—Electricity, Remote and Automatic Electric Controls for Modern Aircraft.* William P. Lear, company president, presented this paper at joint meeting of Franklin Institute, Philadelphia, and local section of AIEE.



After 24 hours' immersion in S.A.E. 20 oil, wick specimens (each .25" diam. x 30" long) of six different types of Booth "prescription" felts were surface-drained and then weighed. Oil absorption as high as 578% of the original weight of specimen was recorded.

Various Booth felt tests, by independent laboratories, may give you new angles on felt. Ask for copies of the reports.

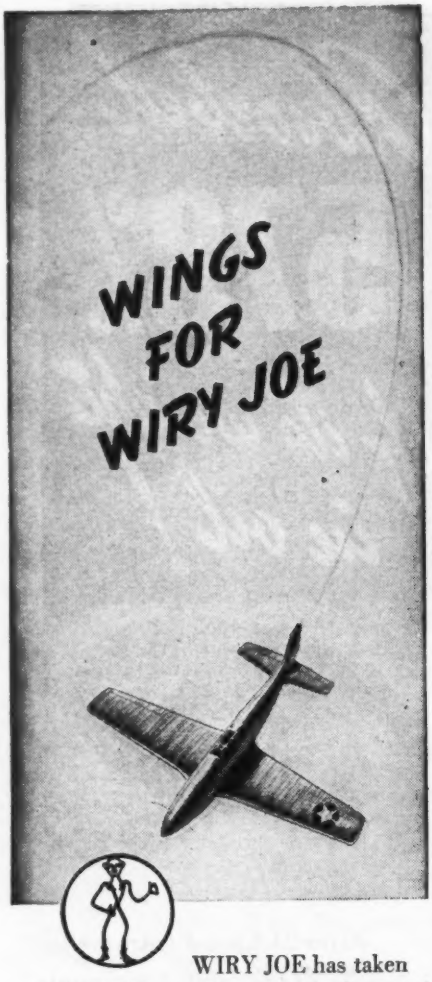
THE BOOTH FELT COMPANY
482 19th Street Brooklyn, N. Y.
745 Sherman Street Chicago, Ill.

APPLICATION CHART AND SAMPLE KIT . . . Contains swatches of S.A.E. felt types, with specification tables. Write for it. (No sales follow-up.)

2074

Booth
TRADE MARK

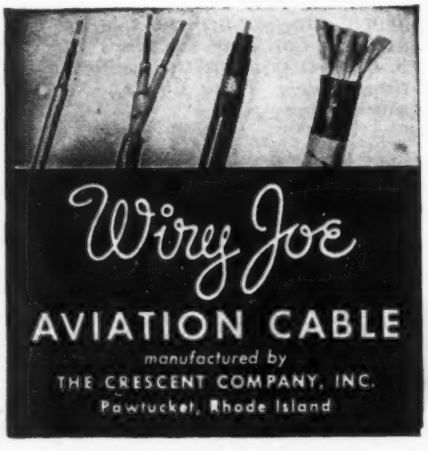
PRECISION CUT FELT PARTS



WIRY JOE has taken to the air! Long famous as the largest independent manufacturer of automotive replacement wiring, Wiry Joe today is an important source of aviation wire and cable.

Produced under the Dostam method of manufacture, to assure uniformity ... dependability ... high efficiency ... long life, Wiry Joe electrical wire and cable for aircraft conforms fully with rigid Army and Navy specifications.

Inquiries concerning electrical wire and cable for any type of service—aviation, marine, automotive, industrial—will receive prompt answer.



Valve Positioner 49

Bulletin No. J602-2 from Wheelco Instruments Co., Chicago, concerns "Throttletrol," described as simplified valve positioning device to be used in conjunction with any control instrument having high and low contact with a neutral position. Operation is described and features detailed.

Plastic Coatings 50

Catalog describing uses of "Americoat" and including list of organic and inorganic materials which it protects against corrosion, is announced by American Pipe & Construction Co., Los Angeles.

Polythene Plastic 51

E. I. duPont de Nemours, Wilmington, Del., offers details from paper, *Some Physical and Chemical Properties of Polythene*, read before American Chemical Society by Dr. F. C. Hahn. Application of plastic by flame-spraying method is among developments detailed.

Booklet on Plastics.....52

Titled *Facts About Plastics, Molded and Laminated,* highly detailed color booklet issued by The Richardson Co., Melrose Park, Ill., is replete with photos and diagrams illustrating types, forms, and applications of various plastics, with specific consideration of company's laminated and molded Insurok. Characteristics of the many types of plastic materials are given, and there are sketch-illustrated suggestions for proper design of parts.

STEEL

Forging Temperatures 53

Evaluating the Forgeability of Steels is booklet offered by Timken Roller Bearing Co., Canton, Ohio, containing recommended forging temperatures of 68 steels, as determined by hot-twist test. Apparatus and procedures used are described and results interpreted.

Metal working 54

Factual information on metal working, heat treating, machining, and rust prevention is given in booklet issued by E. F. Houghton & Co., Philadelphia. This publication has been prepared as supplement to company's regularly issued *Houghton Line.*

MANAGEMENT & EMPLOYEES

Water Heater 55

Circular from O'Brien Steam Specialty Co., Syracuse, N. Y., gives specifications on steam mixer water heater, described as packaged unit consisting of heater, temperature regulator, temperature-pressure relief valve, thermometer and, when desired, water pressure regulator and steam and water pressure gages.

Floor Compound 56

A. C. Horn Co., Long Island City, N. Y., has published bulletin on "Ferem," a floor compound described as containing all desirable characteristics of hardeners, admixtures, and processed components. Product, stated to require only addition of cement and water, is reported to have hardness rating of 9 on Mohs scale.

Contract Termination 57

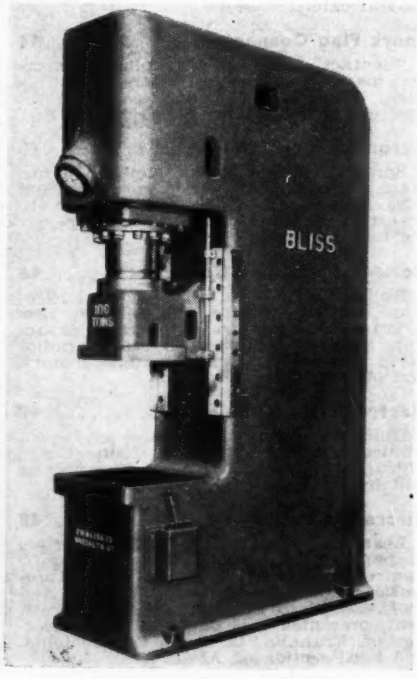
A. B. Dick Co., Chicago, offers booklet, *The A B C of Contract Termination*, describing simplified method of producing numerous papers required for settlement of claims.

NEW PRODUCTS

Latest Machine Tools

Gap Frame Press.....58

E. W. Bliss Co., Brooklyn, has developed new 100-ton gap frame hydraulic press designed to combine rugged frame construction with smooth enclosures. Press is arranged for manual control, but electric control is available for automatic reverse, either by pressure or position. Various types of pumps are available, usually mounted on frame for small production, and on top of frame for high speed production. Modification of bed and slide for special purposes can be made. Some of specifications are: Bed area, 20 x 20 in.; center line ram to throat, 15 in.; max. stroke, 18 in.; overall height, 145 in.; and weight, 25,000 lb. —**AVIATION, Nov., '44.**



Shot Peening Machine.....59

Known as "Wheelapeening" equipment, new machines for shot peening stressed parts, such as gears, springs, crankshafts, connecting rods, milling cutters, and pneumatic drills, have been developed by **American Foundry Equipment Co.,** Mishawaka, Ind. In these machines a rain of metallic shot is directed at high velocity against part, each shot making a tiny dent or pit, cumulative effect being to stretch surface layers by cold working, to put them in state of residual compression. The "Wheelabrator", an airless, centrifugal blast unit, receives shot from hopper to its bladed wheel. An impeller rotates with wheel proper, carrying shot to opening in stationary control cage, where it discharges to bladed section. There, shot is picked up by inner ends of throwing blades and is gradually accelerated in its passage to periphery of wheel. Final throwing velocity is result of radial and tangential forces. Models to give different combinations of motion for peening parts of various shapes and sizes are available.—**AVIATION, Nov., '44.**

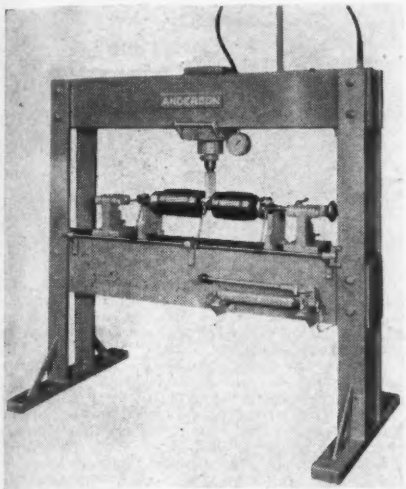
Electric Furnace 60

Model OFE furnace, providing temperatures up to 1,850 deg. F., is new electric unit made by **Thermo Electric Mfg. Co.,** Dubuque, Ia., for heat treating dies and tools and for other industrial and laboratory use. Stated to be improvement is arrangement in which door is supported by two sets of parallel levers that moves door upward and out of way. Heat selection is provided by input controller which automatically turns heat on and off for any desired position of a 1-min. cycle. Instrument panel includes indicating pyrometer calibrated

to 2,000 deg. F., pilot light, and on-and-off switch. Furnace is 21-in. wide, 31-in. high, and 18-in. deep, while chamber is 5⅛-in. wide, 4½-in. high, and 10½-in. deep. Operation is on 115 or 230v., with rated of 2,000 w.—AVIATION, Nov., '44.

Armature Straightener.....61

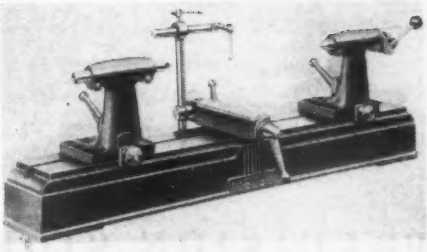
Anderson Bros. Mfg. Co., Rockford, Ill., has produced new armature-straightening press in which three or more indicators are employed to check shaft at vital points. Spring mounted centers are fitted on "V" slide. Ram, of travel-



ing type, rolls on four pre-lubricated bearings, while hydraulic gage is mounted on ram. Capacity is 20 ton, and press will swing armatures up to 14-in. dia. Total length is 65 in., and power is from hand hydraulic pump, which can be replaced with power unit if desired. —AVIATION, Nov., '44.

Bench Center.....62

Designed to meet need for accurate, easily operated inspection and testing devices, **Delta Mfg. Co.**, Milwaukee, announces new bench center in which indicator support bracket has base which can be quickly and firmly locked in any position by means of handle at front. Top surface is flat, and head and tail stocks can be reversed. Both stocks con-



tain 60-deg. angle centers. Maximum distance between centers is 19½ in., over-all length of bed 32 in., and width is 5½ in. Ground bed is 4½ x 30 in.—AVIATION, Nov., '44.

Metal Cutting Saw.....63

New metal cutting band saw, called buttress saw, is announced by **The Do-All Co.**, Des Plaines, Ill. It is designed for rapid production, parallelism, and close tolerance. Tooth gullets are elongated and teeth securely anchored. Made in widths from ¼ to 1 in., with various sets and pitches, saw can also be used for non-metallic materials.—AVIATION, Nov., '44.

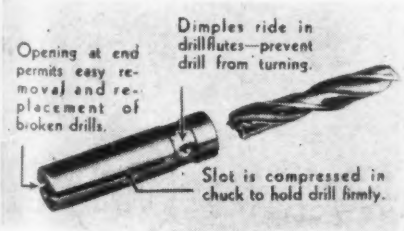
Shop Equipment & Accessories

Circuit Breaker.....64

Now in production is new single-pole circuit breaker for 240v. a.c. and 125v. d.c., 50 amp. max. It may be front or rear connected and has instantaneous trip or selection of three time delays. Measuring 5¼-in. long by 2 11/16-in. high, and 1½-in. wide, breaker is made by **Heinemann Circuit Breaker Co.**, Trenton, N. J.—AVIATION, Nov., '44.

Drill Saver.....65

Stated to enable use of broken drills formerly discarded, new drill holder has been developed by **C-B Tool Co.**, Lancaster, Pa. In operation, broken end of drill is slipped in drill saver, which is then chucked up. Slot in chuck which compresses holds drill firmly, and opening at opposite end is described as permitting easy removal of drill. Drill savers are made to accommodate five drill sizes: Nos. 51 (.067); 41 (.096); 30 (.1285); 21 (.159); and 11 (.191).—AVIATION, Nov., '44.


Opening at end permits easy removal and replacement of broken drills.
Dimples ride in drill flutes—prevent drill from turning.
Slot is compressed in chuck to hold drill firmly.

Fuse Panel.....66

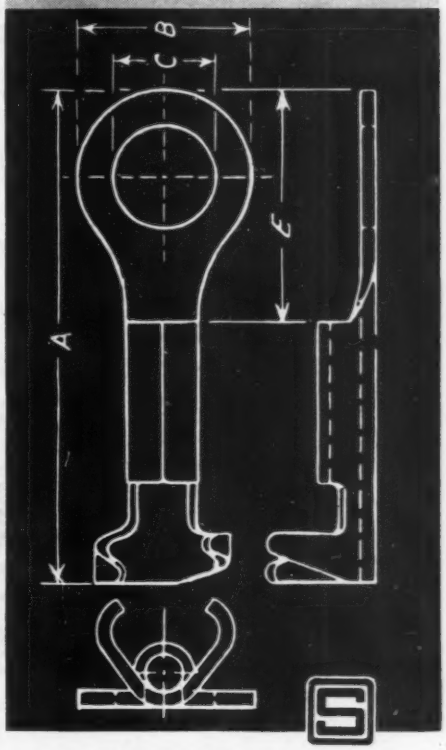
Blueprints available gratis from **Littlefuse, Inc.**, Chicago, are stated to enable manufacturers to save engineering time by selecting factors for fuse panels precisely to their individual specifications. This development is based on company's announcement of its universal fuse panel No. 1505. Panel is for Models 3 A G and 3 A B, 4 A G and 4 A B, and 5 A G and 5 A B Air Corps type of fuses and clips. One number covers mounting. Company states that user has only to check factors for panels on blue print. First dash number indicates fuse specifications, and second dash number specifies number of poles. Specifications include bus bars, if required, and number of poles to be bussed. In aircraft, it is stated that panels can be placed at an accessible point (rather than in central juction box) and can be replaced, under gunfire, by adjacent crew man. Dispersal renders panels less liable to damage.—AVIATION, Nov., '44.

Synthetic Rubber Blend.....67

Stated to be useful in aviation industry for sealants, cements, and acid-resisting coatings, Thiokol "ST" is new type of synthetic rubber described as having low temperature flexibility with-

Get the Specifications On This Improved

One-Piece Solderless Terminal



You'll be amazed to see how production can be increased and performance improved, with the Sherman UNI-CRIMP *One-Piece* Solderless Terminal.

Here's a terminal that insures highest conductivity. It is made of fine grain, specially rolled, pure electrolytic copper, rated at 100% conductivity. And — the entire inside of the barrel is serrated, which provides a strong grip on the entire circumference of the wire, and *greatly increases the contact area.*

Write for Bulletin UC-2, giving full specifications. See for yourself why the UNI-CRIMP is stronger mechanically, more efficient electrically, easier to install, and more economical.

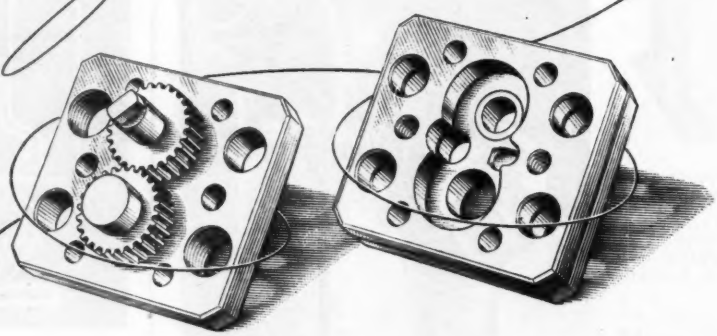
Find out how you can switch over to the UNI-CRIMP and speed up production, without any change in your present set-up.

H. B. Sherman Mfg. Co., Battle Creek, Mich.

The Sherman UNI-CRIMP Solderless Terminal

THE MASS-PRECISION STORY BEHIND

Nylon



Imagine a precision mechanism maintaining its "split-tenths" accuracy while spending its entire life submerged in molten fluid hot enough to soften armor plate in a few minutes.

Du Pont engineers posed this unusual manufacturing problem when they brought the designs of their first nylon pump to Nichols.

From the start, the required alloy stubbornly defied accepted machining and finishing methods, yet surface scratches had to average less than two-millionths of an inch. Lapping to ± .000025″ and gears thicknessed to .00005″ were specified, and the pump was to produce output pressures ten times that needed to make rayon.

Nichols overcame the combined obstacles of heat, pressure and machining to make the first nylon pump. Today these are exclusively manufactured here on a *strictly interchangeable parts and assembly basis* and are used wherever nylon is made.

Such accuracy in over forty years of *mass-precision* manufacturing is traditional at W. H. Nichols & Sons. Specialized facilities and advanced techniques in finish-grinding, lapping, hole location and sizing have developed other products that have been called "the most accurate assembly of commercial parts ever produced."

Have you a product design whose development has reached a manufacturing impasse? Then it's a job to discuss with "Accurate" Nichols.

W. H. NICHOLS & SONS, 48 WOERD AVENUE, WALTHAM 54, MASS.

"Accurate" Nichols

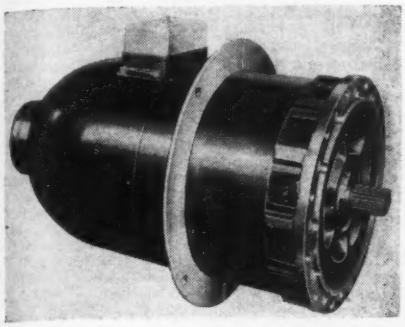
PRECISION ENGINEERING AND MANUFACTURING FACILITIES FOR MASS PRODUCTION.....

ni

out addition of plasticizers, plus resistance to solvents, ozone, and sunlight. It is also described as solution to problem of cold-flow. Maker is **Thiokol Corp.**, Trenton, N. J.—**AVIATION, Nov., '44.**

A. C. Power Supply.....68

To provide a source of either constant or variable frequency for a.c. power, or for rectified d.c. power, Eclipse a.c.-power supply systems, consisting of vari-



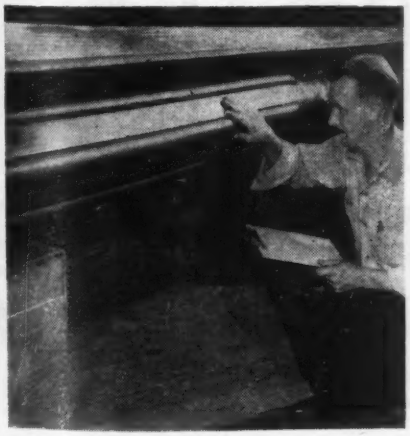
able frequency alternators, carbon pile voltage regulators and compounding units, made by **Eclipse-Pioneer Div., Bendix Aviation Corp.**, Teterboro, N. J., are available in two models, rated at 25 kva. 18.75 kw. and 66.6 kva. 50 kw., weighing 49 and 129 lb., respectively. By installing alternators on constant speed drives, driven by aircraft main engines, source of constant frequency is available, and rectified d.c. power can be obtained, it is stated, from either constant or variable speed operation over rated operating speed range of alternators. Alternators incorporate an integral exciter, and a floating type flexible torque drive shaft compensates for misalignment. Bearings are sealed and prelubricated. Cooling is by integral fan and tubular armature shaft. The 25-kva. alternator delivers rated output between 7,200-8,800 rpm.; 66.6-kva. alternator, between 5,400-6,600 rpm. Photo shows latter model.—**AVIATION, Nov., '44.**

Fastener Installation Tool.....69

New installation tool for Dzus fasteners is announced by **Topflight Tool Co.**, Towson, Md. Reported to solve several problems in use of these fasteners, operation routine is given as follows: 1. Pierce .507 dia. hole; 2. Insert grommet from underside of sheet, put fastener into grommet, and set with single stroke of pedestal squeezer. Maker states tool produces flat panel with head flush, eliminating cracks and distortion.—**AVIATION, Nov., '44.**

Improved De-Icer.....70

B. F. Goodrich Co., Akron, has developed new Type 11 de-icer stated to provide better ice removal and improved tear resistance. With Nylon tubes, it is reported to be thinner and lighter. All-over ply of special elastic fabric encloses wire bead at attachment edge, creating thinner cross section. Highly stretchable Nylon fabric is used in tubes, which pulsate when de-icer operates, tubes being recessed. Back of de-icer is ribbed, forming spanwise channels between



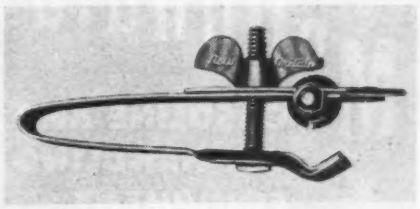
wing-skin and de-icer, which guide trapped air to chordwise channels and vent holes, and also help to spread lubricating talc evenly over surface.—**AVIATION, Nov., '44.**

Electronic Oscillograph.....71

Westinghouse Electric & Mfg. Co., Pittsburgh, announces perfection of new electronic oscillograph, for aircraft engine manufacturers, in which a 50,000v. electron beam generated in cold cathode tube impinges directly upon fixed or rotating photographic film to give sharp, detailed record of electrical phenomena lasting as little as a millionth of a second. Photoelectric control for exposing film carried on rotating drum insures that film will be exposed for one revolution only, it is reported, although drum speed is variable within range up to 7,000 rpm. Electrical phenomena, ranging from spark of an ignition system to lightning striking transmission line, are investigated with this instrument.—**AVIATION, Nov., '44.**

Tube Cutter.....72

New Britain Machine Co., New Britain, Conn., announces new self-feeding tube



cutter, No. T-130, which handles all tubes, and copper, brass or lead pipe from ⅝ to 1 in. dia. Maker states that after tube is inserted and tightened, it need not be reset, also that tension in frame automatically makes deeper cut on each turn. Weighing 6 oz., tool is 5¼ in. long.—**AVIATION, Nov., '44.**

How to get Aircraft Alloy Steels in a hurry

Write for an Aircraft Steel Stock List

Just call one of the numbers below and the aircraft alloy steel you need is practically on its way. Ryerson servicemen are specialists in speed. Your steel requirements will get immediate, expert attention.

Stocks Include:

NE 8630, ROUNDS AND HEXAGONS
Conforms to specification AN-S-14a

X 4130, ROUNDS AND HEXAGONS
Conforms to specification AN-QQ-S-684a

NE 8740, ROUNDS
Conforms to specification AN-S-16a

4140, ROUNDS
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These Plants Carry Aircraft Alloys:

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16th & Rockwell Sts. . . . . Phone—Rockwell 2121

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203 Westside Ave. . . . . Jersey City, N. J.
Newark . . . . . Phone—Market 2-6067
New York City . . . . Phone—Rector 2-3700
Jersey City . . . . . Phone—Bergen 4-1123

ST. LOUIS
5 Clinton St. . . . . Phone—Central 1020

CINCINNATI
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Other Steel-Service Plants:
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Joseph T. Ryerson & Son, Inc.

RYERSON

McDonald

GASOLINE AND OIL HANDLING EQUIPMENT

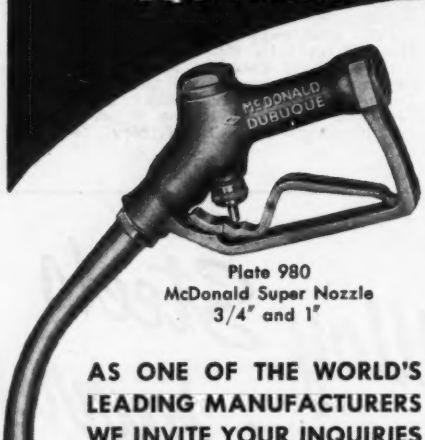


Plate 980
McDonald Super Nozzle
3/4" and 1"

AS ONE OF THE WORLD'S LEADING MANUFACTURERS WE INVITE YOUR INQUIRIES FOR . . .

- ★ HOSE NOZZLES
- ★ SWING JOINTS
- ★ FOOT VALVES
- ★ EMERGENCY AND OTHER VALVES
- ★ VENTS
- ★ PUMP VALVE MANIFOLDS
- ★ LINE STRAINERS
- ★ HAND ROTARY PUMPS, ETC.

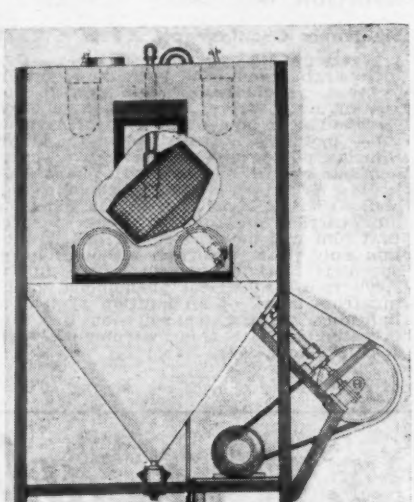
Plate 963
McDonald Top Clean-Out Line Strainer
2" and 3".
Flanged Type Sizes:
3" and 4"

88 YEARS OF DEPENDABLE MANUFACTURE

A. Y. McDONALD MFG. CO.
DUBUQUE, IOWA

Sandblast Cabinet 73

New sandblast unit is combination of cabinet, stationary nozzle, and rotating basket or tumbling barrel, latter being



available for sandblasting small articles, such as nuts and screws. Basket is removable to provide space for larger pieces. Maker is **Leiman Bros.**, Newark, N. J.—**AVIATION, Nov., '44.**

Air Chuck Adapter 74

New collet air chuck adapter is reported by maker, **Redmer Air Devices Corp.**, Chicago, to enable master collet and pads to give capacity up to 4 in. Change-over from standard No. 2 chuck requires removal of stop rod and insertion of adapter; and master collet screws onto this base block, holding collet stationary.—**AVIATION, Nov., '44.**

Power-Drive Lift Truck.....75

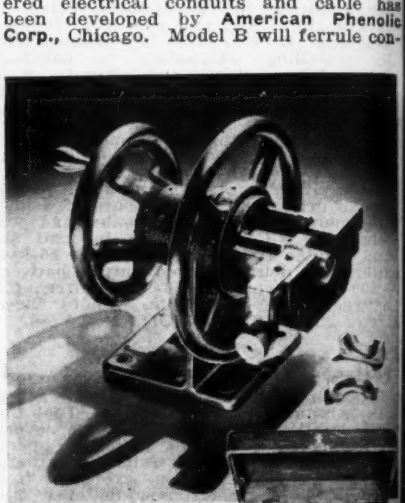
Combination of foot-operated hydraulic lift truck with electric-power front wheel drive called "Transporter" is announced by **Automatic Transportation Co.**, Chicago. Equipment is designed for lifting and short hauling at walking speeds, either on skid platforms up to 6,000 lb. by means of platform type, or pallet unit loads up to 4,000 lb. with fork-type pallet "Transformer". Standard platform lengths are 36 to 72 in., and standard widths 20 and 26½ in., with heights 6, 7, 9, and 11 in. Lift from low to high position is 3½ in. Standard pallet fork lengths are 30 in. minimum to 60 in. maximum in 2-in. steps. Standard width is 27 in., and fork height in low position is 3⅜ in. with 3¾-in. lift. Elevated height is 7⅛ in. Lift is by pump and ram action with foot lever. With front wheel drive constant, drive power is stated to provide for maneuverability in close quarters. Push button forward-and-reverse control is in guide handle, and two speeds forward and two reverse are controlled by lowering or raising guide handle. Brakes are automatic, and steering turntable is ball bearing mounted. Drive has double reduction chain drive from series-type motor. — **AVIATION, Nov., '44.**

Portable Flutter Recorder.....76

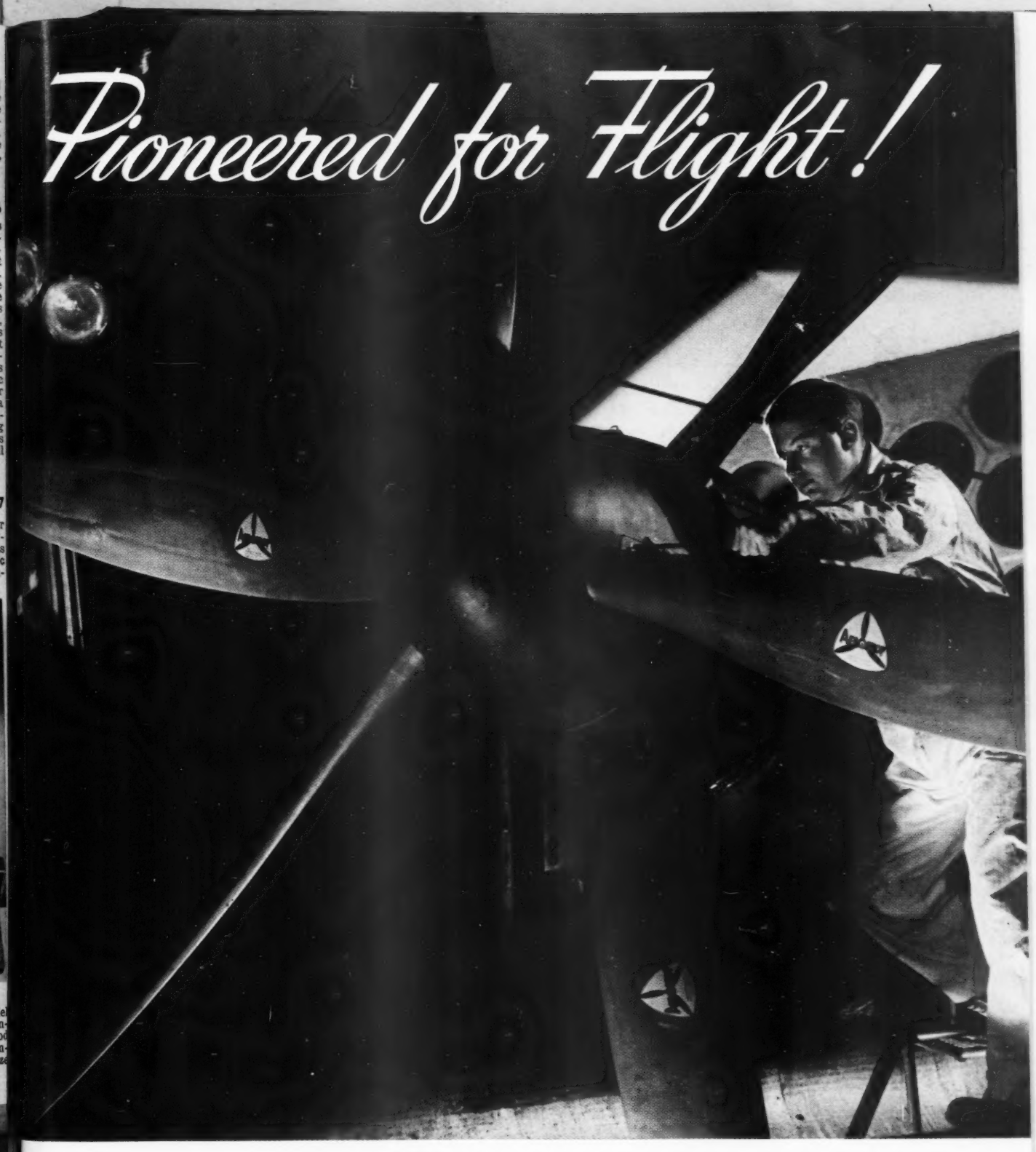
Brown Instrument Co., Philadelphia, is manufacturing new portable flight-vibration recorder developed by CAA, described as a self-contained instrument light enough to be held on lap of observer. Designed to supplement more elaborate equipment in use and to make possible rapid reexamination of doubtful studies and many more tests in difficult cases, velocity or acceleromoter type pickups can be placed at many places about structure, and two of these can be operated simultaneously. Recorder contains its own batteries, amplifier, electronic switch, cathode ray tube, and means for observing record on screen. Camera photographs the oscillograph record. Machine is stated to be useful in studying vibration anywhere about plane, such as in motor mounts, cowling, and in small accessories.—**AVIATION, Nov., '44.**

Ferrule Crimping Machine 77

Portable ferrule crimping machine for use on flexible aluminum and plastic covered electrical conduits and cable has been developed by **American Phenolic Corp.**, Chicago. Model B will ferrule con-



duit from ⅜ to 2½ in. dia.; and Model A, ⅜ to 1¼ in. dia. Collets and mandrels for all sizes are furnished in wood case. Two-step ferrules permit connecting small conduits to larger size connectors.—**AVIATION, Nov., '44.**



THIS GIANT six-blade Aeroprop was developed for specific military use. It is the only dual-rotation propeller now in production for American fighting planes. Despite the unique problems encountered in combining two sets of contra-rotating blades, this propeller embodies the same simplicity, lightness, and strength that are the basic engineering principles of all Aeroprops. Years ahead in design it offers new horizons for the builders of peace-time planes.

Let's Finish the Fight! BUY BONDS!

Aeroprop

ARMY E NAVY

In War and Peace, Propeller Production at its Best!

AEROPROP

AEROPRODUCTS DIVISION • GENERAL MOTORS CORPORATION • DAYTON, OHIO

GM ARMS FOR VICTORY

Rubber stitched to .040ST Aluminum
.040ST Aluminum stitched to .032ST Aluminum
Fabric stitched to .040ST Aluminum
.032ST Aluminum stitched to linen fabric
MORRISON

Stitching

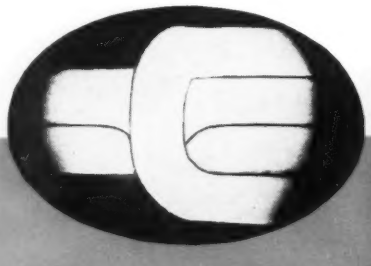
SAVES MANPOWER IN AIRCRAFT ASSEMBLY

One man doing the work of *seven* with use of only half the material . . . those are the mathematics of one particular application of the Morrison Aircraft Metal Stitcher!

In addition, many costly operations requiring the use of highly skilled workers are eliminated. Morrison Stitchers call for no special skill of any kind and require only one operator.

And as for this method of fabrication, it's proven, versatile and fast. Research testings show higher strength and longer life for Morrison – stitched assemblies in a wide variety of assemblies. If you are assembling or fabricating applications of Aluminum, Stainless Steel, Plastics, Cork, Rubber, Asbestos, Wood or Textiles — or any combinations of these materials —investigate Morrison Stitchers. Write for Bulletin F1.

★ BUY MORE WAR BONDS ★



Actual photograph, magnified several times, of cross section of stitch driven through two sheets of .040 24 ST Aluminum.

MORRISON

PRODUCTS OF THE SEYBOLD DIVISION
HARRIS-SEYBOLD-POTTER COMPANY
DAYTON F7, OHIO

STITCHERS

Torque Wrench 78

New "sensory" torque wrench, developed by **F. A. Sturtevant Co.**, Addison, Ill., is stated to add elements of sound and feel to that of vision in indicating

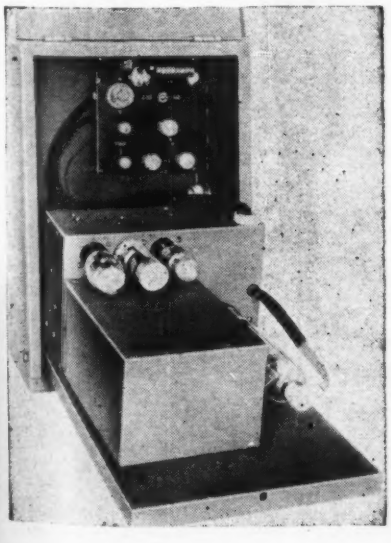
correct torque. Trigger finger, set at any desired signaling point, sounds distinct click and imparts definite impulse to hand at instant set torque is reached.—**AVIATION, Nov., '44.**

Carbide Tipped Tools.....79

Series of new cemented-carbide-tipped tools, designed for use with Jones & Lamson roller turners, is announced by **Carboloy Co.**, Detroit. Tools range in size from ⅜ x ½ in. shank to 1 x 1¼ in. shank, and are for roller turners Nos. TX536, 537, 805, 813, 865, 873, 875, 876, and 1913.—**AVIATION, Nov., '44.**

Timing Unit.....80

Electrical Industries, Newark, N. J., has devised new electronic timing unit for use in controlling resistance welding operations. It is stated to be easily applied to existing or new installations. Single knob controls time from 1 to 28 cycles in steps of one cycle. Welding



current is electronically switched, and device handles welding power of from ½ to 5 kva.—**AVIATION, Nov., '44.**

Rust Inhibitor 81

Witco Chemical Co., New York, announces new rust-preventive coating for metal parts and equipment. Applied by spraying or dipping, it is stated to have melting point in excess of 2,500 deg. F and to remain flexible at 20 deg. below zero.—**AVIATION, Nov., '44.**

Pre-Cleaner Unit 82

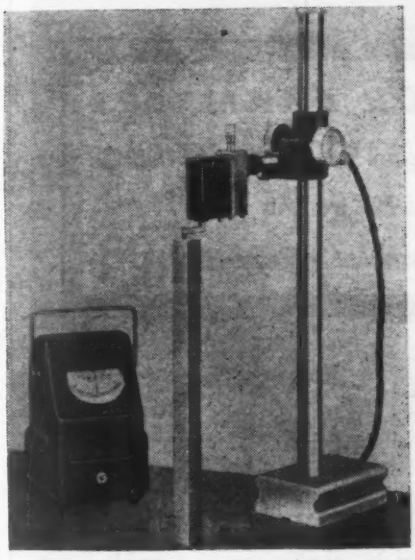
Aget-Detroit Co., Ann Arbor, Mich., is marketing new pre-cleaner unit to be used with Model 600 dust collectors. Stated to have large storage space for waste material, unit can be supplied complete with power unit, or separately for company dust collector models now in use. Pre-cleaner consists of cabinet containing large dust storage bin and cylindrical centrifugal separator. In operation, virtually all waste matter is stated to be separated from air-stream by pre-cleaner unit; pre-cleaned air is then drawn through fan and returned after passing through spun glass filter at top of dust collector. Storage bin has capacity of 2 cu. ft. Unit is 18 x 25 in., with height (less model 600 collector) 30 in.—**AVIATION, Nov., '44.**

Grease Gun.....83

Alemite Div., Stewart-Warner Corp., Chicago, has developed electric portable power grease gun, Model 7190, for industrial use. It is equipped with heavy duty wheels and ball bearing front caster. Driving device connects ⅓-hp. motor to high pressure grease piston and cylinder. Mercury switch automatically shuts off motor when 5,000 lb. pressure is built up.—**AVIATION, Nov., '44.**

Height Indicator.....84

For use on surface plate, new type of precision height indicator with "Electrigage", is announced by **Sheffield Corp.**, Dayton, Ohio. Instrument includes surface plate block, 26-in. column with rack, and Electrigage (1000-1 amplifica-



tion, smallest graduation .0001 in.), with electric pickup head mounted on adjustable extension arm. Micrometer is provided for ½-in. vertical adjustment of pickup head, described as allowing operator wider range or rough comparison measurements. Mounting bracket is adjustable vertically with capacity of 0 to 18 in. Extension arm can be adjusted to bring head to any location, with throat capacity-gaging point to edge of column, 4½ to 11 in., and gaging point to edge of base, 3½ to 10 in. Head can be rotated and locked in position with full range of 360 deg., while fine-adjustment knob facilitates setting-up.—**AVIATION, Nov., '44.**

Automatic Washer.....85

Turco Products, Los Angeles, announces new washer for cleaning oil temperature regulators. It is described as capable of cleaning and reclaiming regulators heretofore discarded. Seven

Cools the
HOT
SPOT!
We've engineered and built thousands of small, fractional H.P. blower motors for operating cooling fans for hot spots such as radio tubes and transformers in many types of aircraft and radio installations. Competent engineering and precision manufacturing facilities assure volume production of small motors designed to your exact performance specifications—for any job that requires compact, lusty, dependable power. Tell us your requirements.
Small Motors, Inc.
1312 ELSTON AVE., CHICAGO 22, ILLINOIS
Design • Engineering • Production

different cleaning operations are performed, it is stated, by turning clearly identified valves on front panel. Two cleaning compartments in "Surf" washer, individually controlled, are enclosed in metal cabinet 8 ft. long, 3 ft. deep, and 62 in. high.—**AVIATION, Nov., '44.**

Portable Kilovoltmeter 86

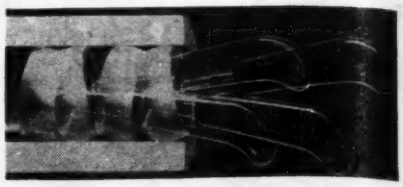
Shallcross Mfg. Co., Collingdale, Pa., announces new portable 2-scale d.c. kilovoltmeter, Type 722, scales of which cover 0-2 kv. and 0-20 kv.—**AVIATION, Nov., '44.**

Engine Preheater 87

New 45-lb. aircraft engine preheater, designed to hang on propeller of radial engine, is announced by **Hunter & Co.**, Cleveland. Unit, measuring 18½ x 5½ x 13¼ is rated at 40,000 btu./hr., is equipped with canvass hood to enclose engine, and has short connecting ducts for hot and return air. One heater is applied to each engine, and short travel of heat is to assure minimum heat loss. Components are welded steel burner, small blower, built-in fuel tank, and controls.—**AVIATION, Nov., '44.**

Fixed Limit Gage.....88

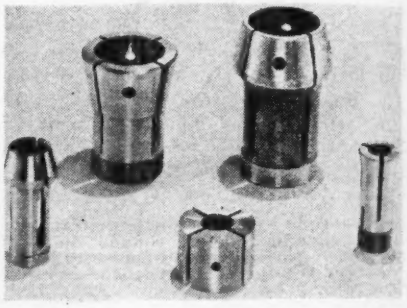
Improved "TeBo" fixed limit type gage for bore-gaging is now produced in the Americas by **Standard Gage Co.**, Poughkeepsie, N. Y. Gaging Head is a section of sphere with plating of hard chromium which, with the spherical shape, is described as retaining extreme accuracy over long periods. Spherical head is stated to contribute to frictionless operation and effortless insertion and withdrawal, eliminating jamming. On periphery of head is a smaller projection which is also part of true sphere and which may be adjusted to limit of maximum tolerance to compensate for



wear by means of two tapered screws, the adjustment of which also increases or decreases "no go" factor within gage's dimensional limits. When bore is between maximum and minimum tolerances, head enters freely and may be rocked on its horizontal axis until stopped by projection. If bore exceeds maximum tolerance, released gage handle drops below bore axis. It will also drop when gage encounters such irregularities as out-of-roundness, taper, belling, ovalness, or faulty finish. Handle is balanced to weight of head. Its position, as well as "feel", indicates condition of bore. Handles are insulated from heat of hand. It is stated that maximum and minimum dia. may be gaged in one operation. Illustration shows phantom view of gage in different positions.—**AVIATION, Nov., '44.**

Collets and Pads.....89

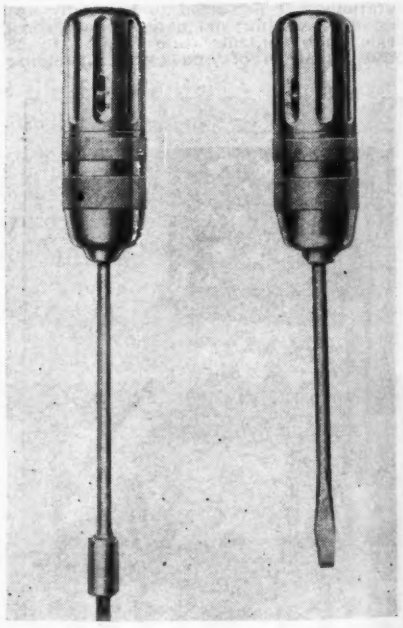
Zagar Tool Co., Cleveland, announces addition of collets and collet pads to its line, types available being 5-c draw type



and No. 2 W & S type, as well as No. 6 W & S type master collets, all of which are available in rounds, hexes, or squares. Photo shows collets.—**AVIATION, Nov., '44.**

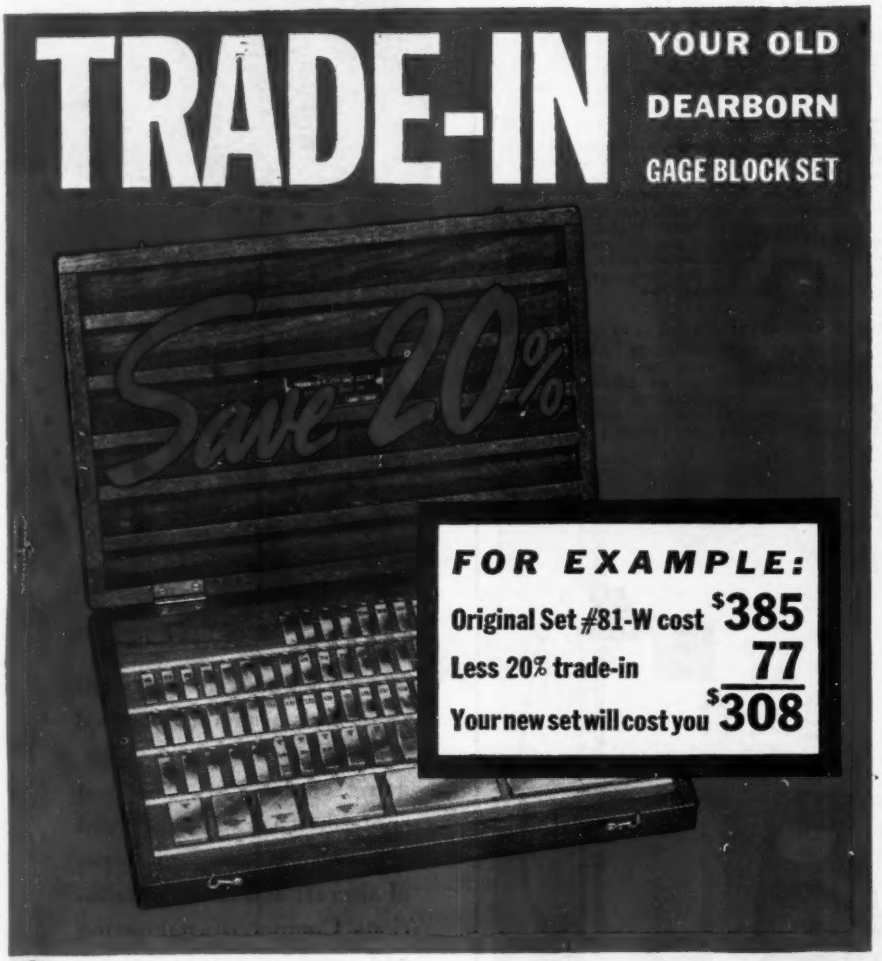
Torque Screw Driver.....90

New torque screw and bolt driver described as eliminating over or undertightening, thread stripping, or material damaging, is announced by **Richmont, Inc.**, Los Angeles. Tool is Livermont



TRADE-IN

YOUR OLD DEARBORN GAGE BLOCK SET



YOU can now turn in your used Dearborn Gage Block sets for reconditioning, and we will send you a brand-new set of Dearborn blocks (rectangular) and allow you a 20% discount on the new set. Yes, these Dearborn sets will be new, not reconditioned, and they will all have the **exclusive Ellstrom feature of Chromium Plated Gaging surfaces that insure longer wearing millionths.**

On all other makes of gage block sets we will allow a 10% discount on a new Dearborn set when you turn in these used sets for reconditioning.

In addition to the discounts allowed, we allow you to hold your old set until we deliver your new Dearborn set.

Write today for prices and delivery.

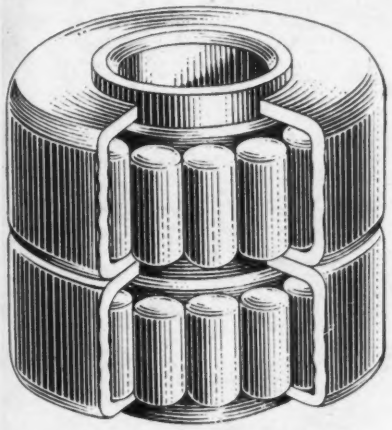
DEARBORN GAGE CO. 22035 BEECH STREET DEARBORN, MICHIGAN

Originators of Chromium Plated Gage Blocks

"Roto-Torq." Adjustable between 1 in.-lb. and 25 in.-lb., it disengages itself at proper torque, with operation on spring principle. Two models are available, one with screw driver and one with ¼-in. square drive.—AVIATION, Nov., '44.

Needle Bearing for Pulleys.....91

Designed to minimize friction in aircraft pulley applications, new double-row PN needle bearing (see photo) has



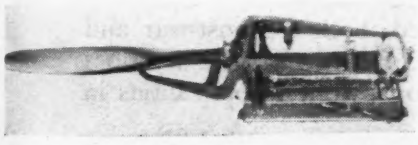
been developed by **The Torrington Co.**, Torrington, Conn. Full complement of small diameter needle rollers is stated to provide capacity to meet all requirements. Small outside diameter is for saving of weight. Enclosed design is stated to retain lubricant without excess grease.—AVIATION, Nov., '44.

Miniature Oscillograph 92

To directly record small values of potential or current, such as output of amplifying equipment, new miniature six-element self-contained permanent-magnet oscillograph is announced by **General Electric Co.**, Schenectady, N. Y. Weighing 10 lb. and enclosed in case measuring 4½ x 4½ x 24 in., instrument consists of three principal systems: Optical system; six parallel galvanometer channels; and photosensitive-material transporting mechanism with internal motor and removable film holder. Wide range of potentials or currents can be recorded, it is stated, by use of appropriate external resistors, instrument transformers, or shunts. — AVIATION, Nov., '44.

Propeller Scale 93

Howe Scale Co., Rutland, Vt., announces new scale designed for static balancing of propeller blades to precision limits. Balance is obtained by



inserting butt end of blade into clamping socket on scale until it touches two contact stops which are set same distance from fulcrum pivot as butt would be from center of hub of propeller shaft. Two lamps are lighted when butt end is properly located. Weights are lifted by lever action, a graduated indicator provides readings, special mechanism locks lever in position, and a relieving device raises fulcrum knife-edges off bearings when blades are being mounted or removed. Six counterpoise weights are provided.—AVIATION, Nov., '44.

Hardening and Quench Table.....94

Induction Heating Corp., New York, is marketing new general-purpose, two-station hardening and quench table used with high-frequency induction heating generators and reported suited to variety of machine parts requiring surface hardening or localized heating. Table has quick change coil connections and can be used as single purpose unit or as general purpose table for various operations on large or small runs. Initial timer

All to your advantage

CANNON QUALITY CONTROL is our investment but you collect the dividends. Let's see how.

We mill all contacts to extremely close tolerances. You get the benefit of low voltage drop. We die cast fittings. You gain strength and save weight. We pioneered the split shell. You (collectively) save hundreds of thousands in the cost of wiring and assembly.

All along the line we take extra care in manufacture. We test, inspect and check again. You have the assurance that, whatever else may fail, the Cannon Plugs you use are dependable.

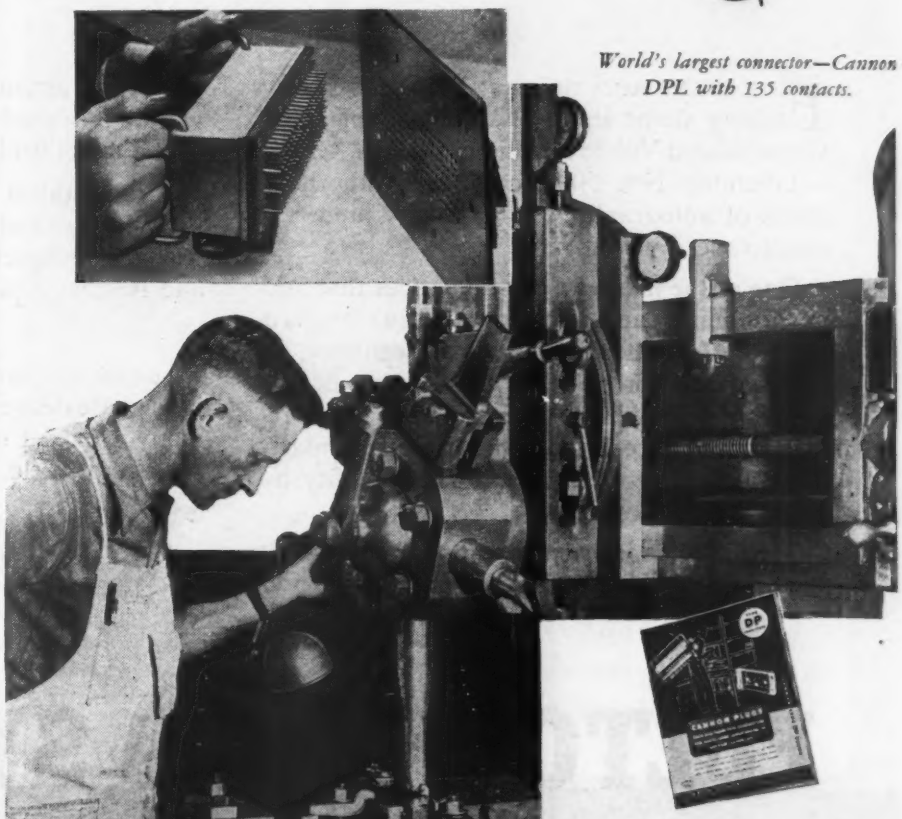
All that is worth a lot to you isn't it? It's our investment in your good will.

CANNON ELECTRIC

Cannon Electric Development Co., Los Angeles 31, California

Canadian Factory and Engineering Office:
Cannon Electric Company, Limited, Toronto

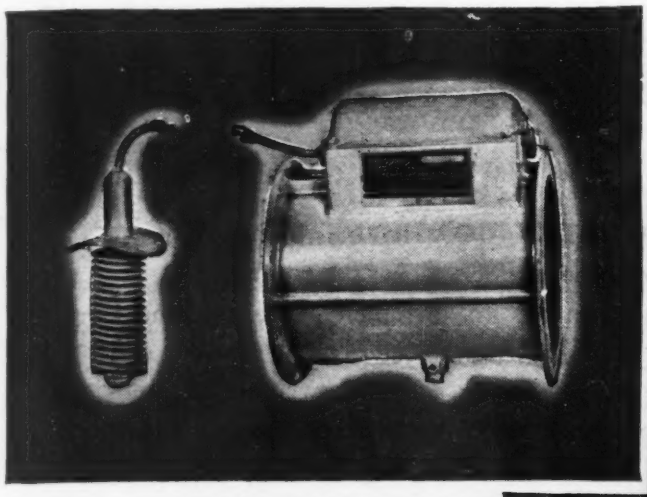
Representatives in principal cities — Consult your local telephone book



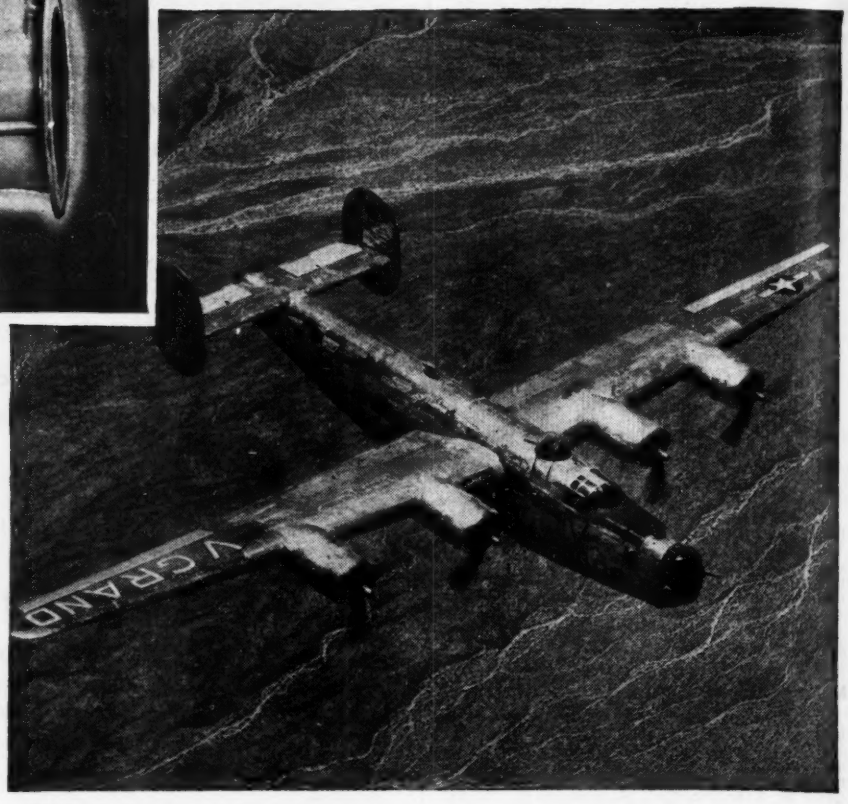
World's largest connector—Cannon DPL with 135 contacts.

DP Connector Bulletin

32 pages giving complete data. Free on request. Address Department A-110, Cannon Electric Development Co., 3209 Humboldt Street, Los Angeles 31, California.



No. 707 Sylphon Temperature Regulator. This instrument comprises a thermostatically controlled valve, which proportions the mixture of hot and cold air admitted to the heater ducts—to maintain a constant temperature in the flight deck and bombardier's compartment.



CONTROLLED WARMTH FOR THE "OFFICE"

FIVE YEARS AGO the first B-24 was slowly taking shape in the San Diego plant of Consolidated Vultee . . . and now the V-Grand —Liberator No. 5000, complete with thousands of autographs, has joined its predecessors to speed victory.

One of the many automatic devices that add to the comfort and efficiency of B-24 crews is a Sylphon Aircraft Temperature Regulator. It automatically proportions the mixture of hot and cold air to maintain a constant, comfortable temperature in the bombardier's compartment and control room (known familiarly by airmen as the "office").

This Sylphon instrument is but one of many successful applications of time-proven Sylphon Bellows to aircraft design. Their post-war uses will be universal in the temperature and pressure control fields.

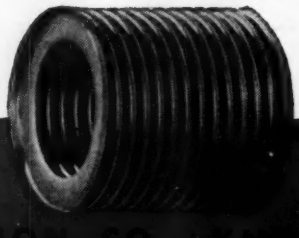
A fully staffed engineering consultant service is available at all times without obligation to users or prospective users of Sylphon Bellows and Bellows Assemblies.

* * *

Inquiries are invited, both for post-war and immediate delivery. Bulletin VA-822 describes many typical Fulton Sylphon applications in the aircraft field.

A new movie film—"The Story of Metal Bellows"—is available to interested executives and organizations.

ARMY E NAVY

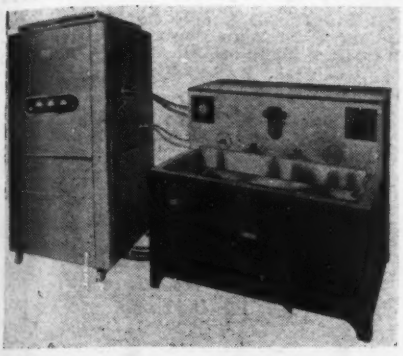


FULTON SYLPHON

TEMPERATURE CONTROLS BELLOWS BELLOWS ASSEMBLIES

THE FULTON SYLPHON CO., KNOXVILLE 6, TENNESSEE

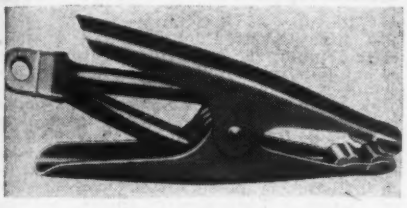
Canadian Representatives, Darling Brothers, Limited, Montreal



records heating time on new part or job, after which timer action is replaced by selector switch action. Table is also equipped with 3-stage timer automatically controlling heating and quenching positions of cycle, also making possible a slight delay between sequences, it is reported, when this type of treatment is required. Hose connections to quench rings provide spray. Master timer, operating solenoid valve, controls duration of quench. Two rotary drive spindles for gears, reported to assure uniform heating, are controlled by individual selector switch. Other modifications are available.—**AVIATION, Nov., '44.**

Welding Ground Clamp.....95

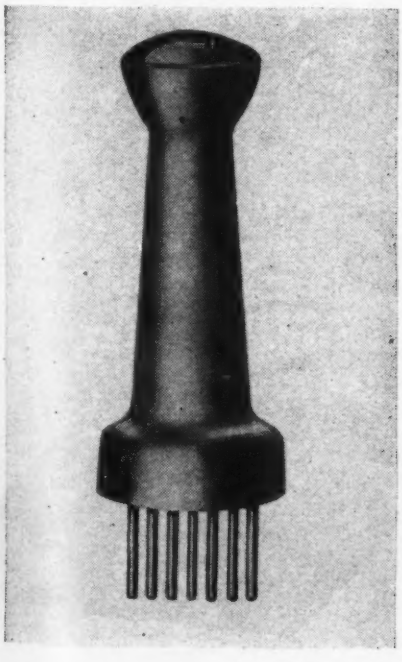
Lincoln Electric Co., Cleveland, announces new ground clamp for welding, designed so each jaw connects inde-



pendently to ground cable, described as assuring proper contact. Unit weighs 1⅛ lb., has max. jaw spread of 2½ in., and is rated at 300 amp.—**AVIATION, Nov., '44.**

Miniature Socket Plugs.....96

Designed for manufacturers using miniature tubes, socket wiring plugs made by **Radio Accessories Div., Star Expansion Bolt Co.,** New York, are described as providing accurate alignment of socket contacts during wiring, thereby minimizing tube failure due to glass strains.—**AVIATION, Nov., '44.**

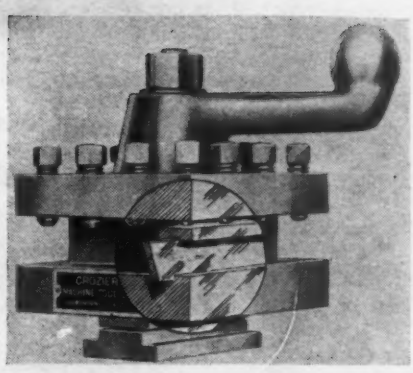


Alloy Boring Blades.....97

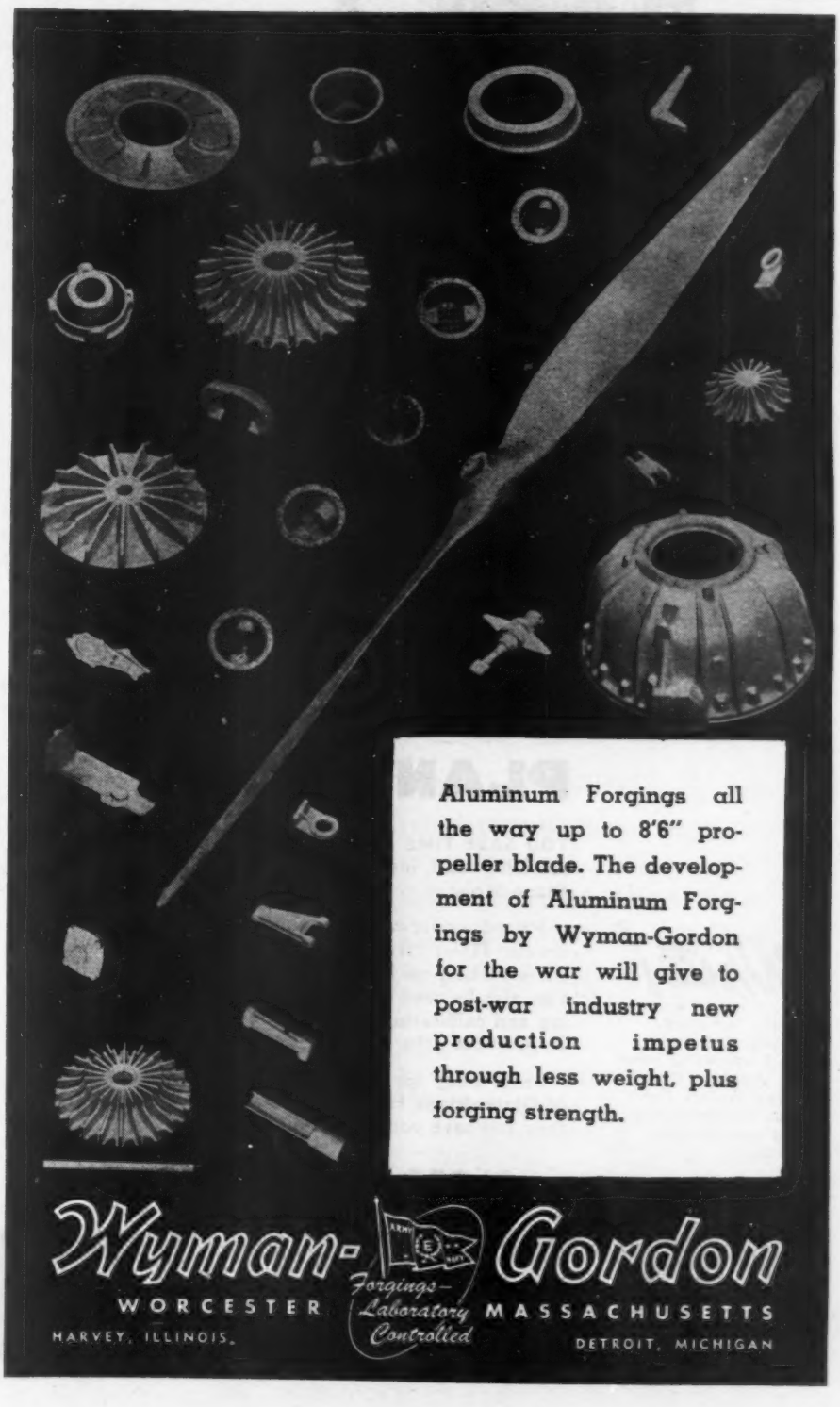
Haynes Stellite Co., Kokomo, Ind., announces boring and reaming blades made of company's stellite cobalt-base alloy. Boring blades are used for rough and finish boring operations on cast iron, malleable iron, brass and bronze, and for rough and semi-finish boring operations on steel. Reamer blades are used chiefly on cast iron, although it is stated they have been successfully used on malleable iron, brass, and bronze. Blades are available in 98M2 and Star J-metal, to users' specifications — **AVIATION, Nov., '44.**

Tool Post Turret.....98

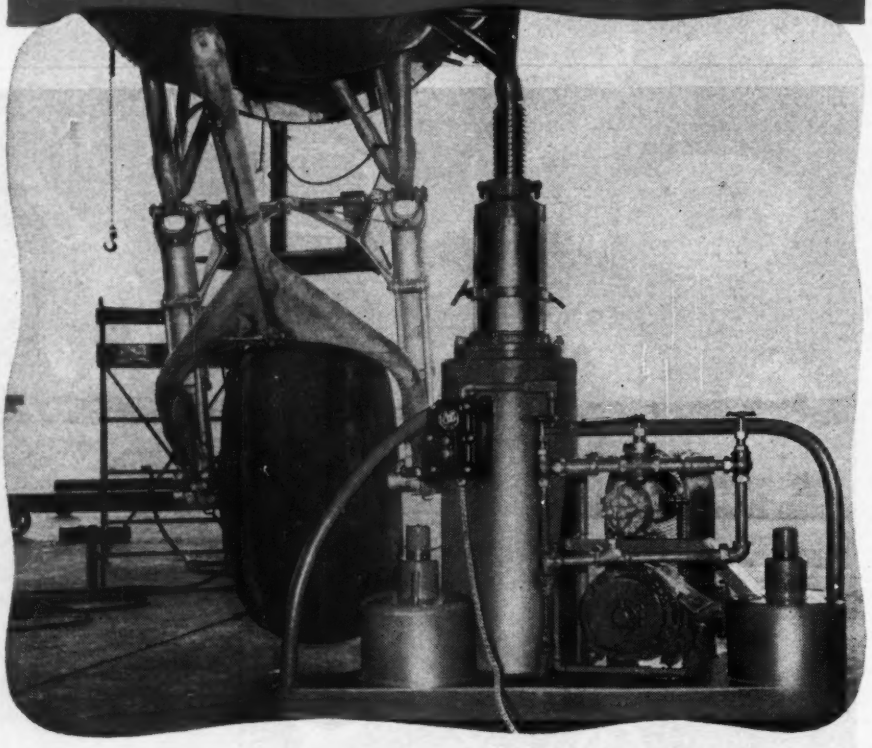
New tool post turret for bench lathes, specially adapted for cutting-off operations, is announced by **Crozier Machine Tool Co.,** Hawthorne, Calif. One side of block is channeled to receive standard beveled-section cut-off blade, with support at top by channeled bar, providing



maximum bearing surface for locking bolts. Holder does not overhang.—**AVIATION, Nov., '44.**


Aluminum Forgings all the way up to 8'6" propeller blade. The development of Aluminum Forgings by Wyman-Gordon for the war will give to post-war industry new production impetus through less weight, plus forging strength.
Wyman-Gordon
Forgings—Laboratory Controlled
WORCESTER MASSACHUSETTS
HARVEY, ILLINOIS. DETROIT, MICHIGAN

SPEED UP PLANE SERVICING



—with a **GLOBE *portable* PLANE HOIST**

YOU SAVE TIME AND WORK a dozen ways in plane servicing and inspection with this Globe Portable Plane Hoist.

Placed under wing jacking pads, the Globe Hydraulic Hoist "free wheels" the plane in a moment, for servicing of landing gear mechanism and tires. Can also be used to "flight position" plane for checking and calibrating instruments, armor, and controls. It gets the jobs done QUICKER, and BETTER.

Send today for illustrated circular on the full line of Globe Plane Hoists, and the many ways in which they can save you time and money.

Write!

Write for illustrated Bulletin AV-3 showing newest types of Globe Plane Hoists for your maintenance and production needs.

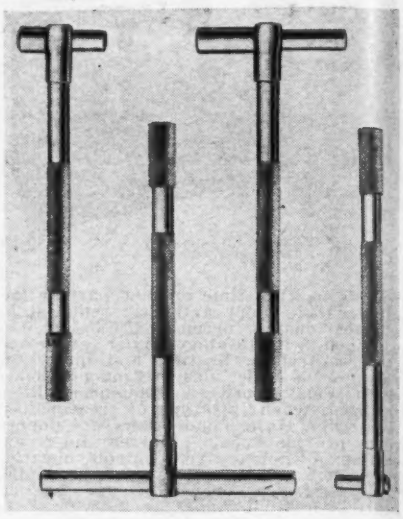
GLOBE HOIST COMPANY

Philadelphia 18, Pa. . . . Des Moines 6, Iowa

GLOBE HYDRAULIC PLANE HOISTS

Telescoping Gages.....99

Brand Tool & Supply Co., Los Angeles, announces introduction of new telescoping gages, made in four sizes: $\frac{5}{16}$ to 12 in.;



$\frac{1}{4}$ to $\frac{3}{4}$ in.; $\frac{3}{4}$ to $1\frac{1}{4}$ in.; and $1\frac{1}{4}$ to $2\frac{1}{4}$ in. They may be had in sets of three gages from $\frac{1}{2}$ to $2\frac{1}{8}$ in.; or sets of four, from $\frac{5}{16}$ to $2\frac{1}{8}$ in.—**AVIATION, Nov., '44.**

Distributor Tester.....100

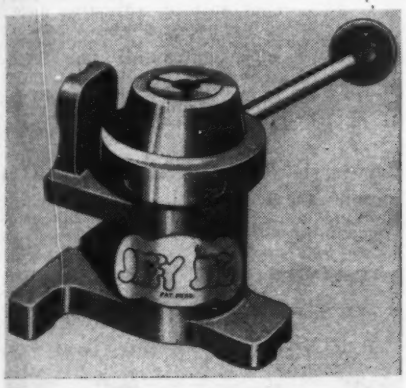
"Isotronic - Distributorgraph" Model 500, manufactured by **Lanagan & Hoke**, Philadelphia, is new distributor tester. Accompanying illustration shows distributor positioned in adjustable arm and connected to variable speed motor for rotation under rheostat control at any speed to 2,500 rpm. Movable scale ring, graduated in degree for either direction, surrounds drive shaft, and fitted in housing is power pack for operation of tubes. Tachometer shows rotating speed, and switch selects direction. Vacuum pump and gage are included for application to vacuum-advance mechanism. Disk in center of panel rotates with distributor shaft and carries two electronic tubes, red and blue, mounted at 180 deg. to each other around disk, and they light when contacts close, lighting occurring at same position on circular scale if distributor is in good condition. Tubes produce red light bar at each firing-interval point, red light blanking out blue light. A worn camshaft or bushing will light blue tube out of phase with red, so both red and blue bars are visible. Degrees in arc between two gives reading of the error. Actual number of degrees of cam travel during which points are both open and closed are read by turning switch and noting reading between light bars on scale.—**AVIATION Nov., '44.**

Hole Punching Technique 101

Horizontal Type-H hole punching units, made by **Wales-Strippit Corp.**, N. Tonawanda, N. Y., are offered for hole punching in flanges, angles, container sides, and similar-shaped work. New technique of punching holes in sides, instead of in top of flat surfaces, is made possible, it is stated, by designing unit so that punch moves horizontally instead of vertically.—**AVIATION, Nov., '44.**

Lever-Operated Chuck 102

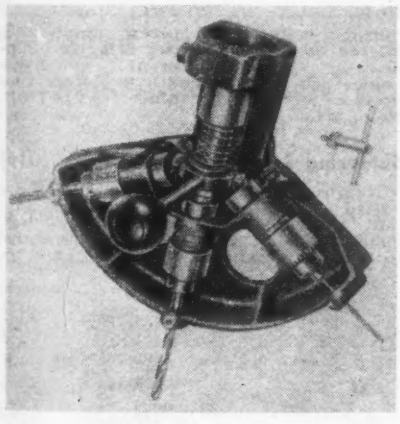
"Jiffy Jig," new lever-operated chuck made by **Monarch Governor Co.**, Detroit, is designed to be set up in either horizontal or vertical position and, when either open or closed, to hold collet to zero axial movement. Chuck consists of cap, base, and operating lever, taper on cap conforming to that of collet. With proper-size collet in place, cap is screwed down on base until collet opens and



closes as desired. Operating lever is then screwed into convenient location, and chuck is ready for use. Chuck may also be used in conjunction with automatic spring ejector, and Warner Swasey #2 collets may be substituted.—**AVIATION, Nov., '44.**

DRILL PRESS HEAD.....103

New drill press turret head holding three tools is announced by **Universal Engineering Co.**, San Diego, Calif. Attachment is made by removing chuck



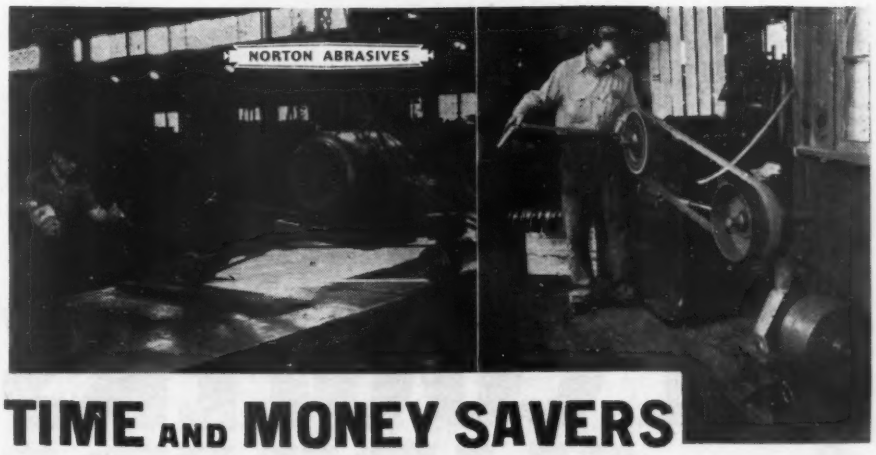
and depth gage and slipping bracket over quill. Capacity of head is ¼-in. drill size, and Jacobs chucks are furnished. Light movement of indexing lever shifts position of tools.—**AVIATION, Nov., '44.**

Self-Flaring Coupling 104

Providing a union effect, self-flaring coupling for plastic tubing, made by **Packless Metal Products Corp.**, New Rochelle, N. Y., is described as forming its own flare without thinning or splitting ends and without preheating of plastic. Coupling is for tube sizes ¼ to ¾-in. o.d.—**AVIATION, Nov., '44.**

Air-Operated Controllers.....105

New series of indicating, air-operated control instruments, for controlling temperature, pressure, vacuum, liquid level, and humidity, is announced by The



TIME AND MONEY SAVERS

Swing Frame Grinders, Idler Backstands using METALITE CLOTH *Belts*

The pressure for speed in turning out war materials greatly accelerated the installations of such machines—Swing Frame Grinders and Idler Backstands, both employing fast-running abrasive belts.

But long before that, increasing numbers of plants had reaped the many benefits inherent in these modern mechanical aids that do better work faster and at much lower costs than old methods. In some cases four times the output, in others at a reduction of 75% in time.

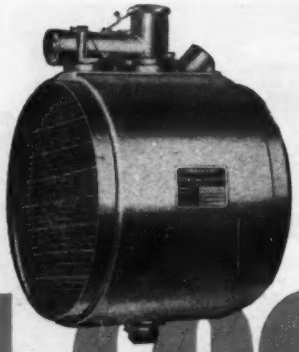
These records forecast further and faster adoption of such time and money saving methods which could well have the prompt attention of all mechanical and purchasing personnel.

We will gladly supply information on the equipment (which we do not sell) as well as on the specially designed Metalite Cloth Belts (which we do).

Just a few lines on your letterhead

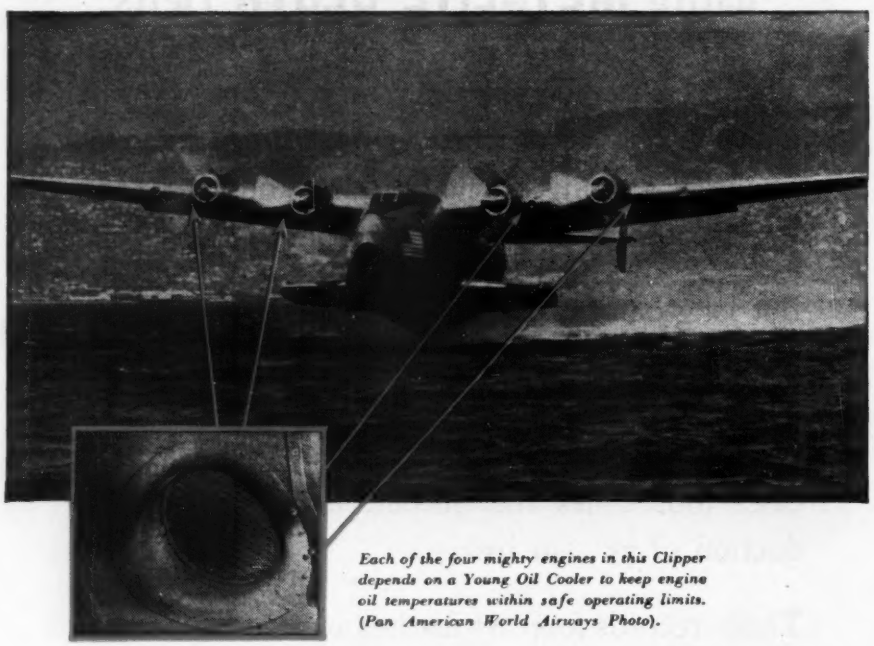
Offer valid only in U. S. A.

BEHR-MANNING · TROY, N.Y.
(DIVISION OF NORTON COMPANY)
RELIABLE COATED ABRASIVES SINCE 1872



ANOTHER EXAMPLE OF **YOUNG** AVIATION SERVICE

OIL COOLERS for CLIPPERS



Each of the four mighty engines in this Clipper depends on a Young Oil Cooler to keep engine oil temperatures within safe operating limits. (Pan American World Airways Photo).

Young is proud to have had a part in spanning the skyways of the world. Experience that began thirty years ago made it possible for Young Heat Transfer Products to contribute to the amazing development of commercial aviation, climaxed by giant Clipper ships encircling the globe. When war broke out Young engineers were ready! They produced equipment that could stand the punishment of fast flying, long trips, furious fighting. They did more . . . they developed automatic accessories and controls to regulate temperature and flow of coolants for quick take-offs, power dives and steep climbs, thus freeing pilots and crews for concentration on combat. And now, though still deep in war work, Young engineers are finding time to put thought on the heat transfer problems of the postwar world. Consult with them, without obligation.

YOUNG RADIATOR CO., Dept. 294-L, Racine, Wis., U.S.A.

Distributors: Pacific Airmotive, Burbank, Cal. Aircraft Steel & Supply Co., Wichita, Kansas

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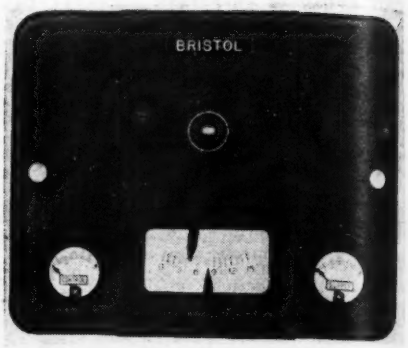
BUY BONDS • PRODUCE MORE • SALVAGE SCRAP • WIN THE WAR

HEAT TRANSFER PRODUCTS

Oil Coolers • Gas, Gasoline, Diesel Engine Cooling Radiators • Intercoolers • Heat Exchangers • Engine Jacket Water Coolers • Unit Heaters • Convectors • Condensers • Evaporators • Air Conditioning Units • Heating Coils • Cooling Coils • and a Complete Line of Aircraft Heat Transfer Equipment.



Bristol Co., Waterbury, Conn. Operating on free-vane principle of automatic control, they have throttling range of from ½ to 15 percent with an adjusting mechanism stated to enable changes without use of tools. Model 93 is a direct set instrument for controlling any value within its range by setting control pointer, and it can be changed from reverse to direct action, or vice versa, by finger action.—**AVIATION, Nov., '44.**

Countersink Gage 106

Countersink gage designed to check machine countersinks for size and shape for grinding and sharpening, as well as

finished countersunk screw adapters, is offered by **Dayton Rogers Mfg. Co.**, Minneapolis. Five different countersink angles are included, with two gage view profiles in each instance.—**AVIATION, Nov., '44.**

Soldering Stand 107

Improvements in soldering stands are stated to be embodied in Model SS10 unit, made by **Ess Specialty Corp.**, Bergenfield, N. J. New features are stated to permit maximum freedom for work

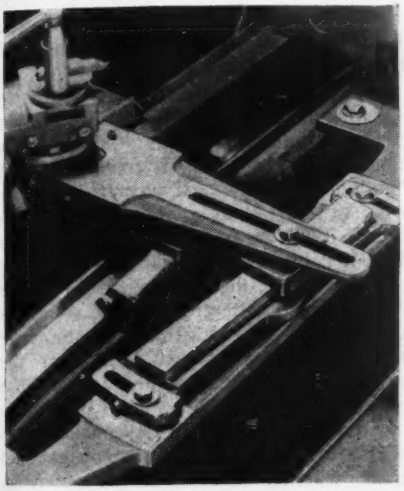
passing, enabling operator to focus attention on joint by means of magnifying or plate glass window, with protection for operator from fumes. Stand is supplied either with bracket for table mounting or with its own wood base. Fume stack is 3 x 9¼ x 32 in.—**AVIATION, Nov., '44.**

Cement-Floor Treatment 108

"Syncrete Concentrate" is new liquid treatment for cement floors stated to penetrate pores, harden to rocklike mass, and reinforce binder, eliminating dust and preventing wear. Maker is **Synthex Products Co.**, New York.—**AVIATION, Nov., '44.**

Taper Attachment 109

New taper attachment reported to make taper turning, boring, and threading as easy as straight line tool operation, is announced by **Master-Taper Co.,**



Chicago. For use in any position on lathe, maker states it does not interfere with straight turning. Sliding fixture has straight gibs. Graduations are in inches at one end, and in degrees at other end of swivel bar. It tapers up to 3½ in. per ft., 16½ deg. max. in either direction, and 7½ in. in length at one setting.—**AVIATION, Nov., '44.**

Helicopter Future?

(*Continued from page* 117)

of the machine. Helicopter research is practically nil compared with the vast amount that has been done on the conventional airplanes. As the fund of knowledge grows, the entire outlook cannot but change accordingly.

The helicopter comprising essentially a single main rotor with torque-compensating tail rotor is but one type. Research may reveal other types as being ultimately more practical—or it may develop some completely undreamed-of mechanical means of doing the job that would make our present thinking as out-of-date as a 1910 automobile.

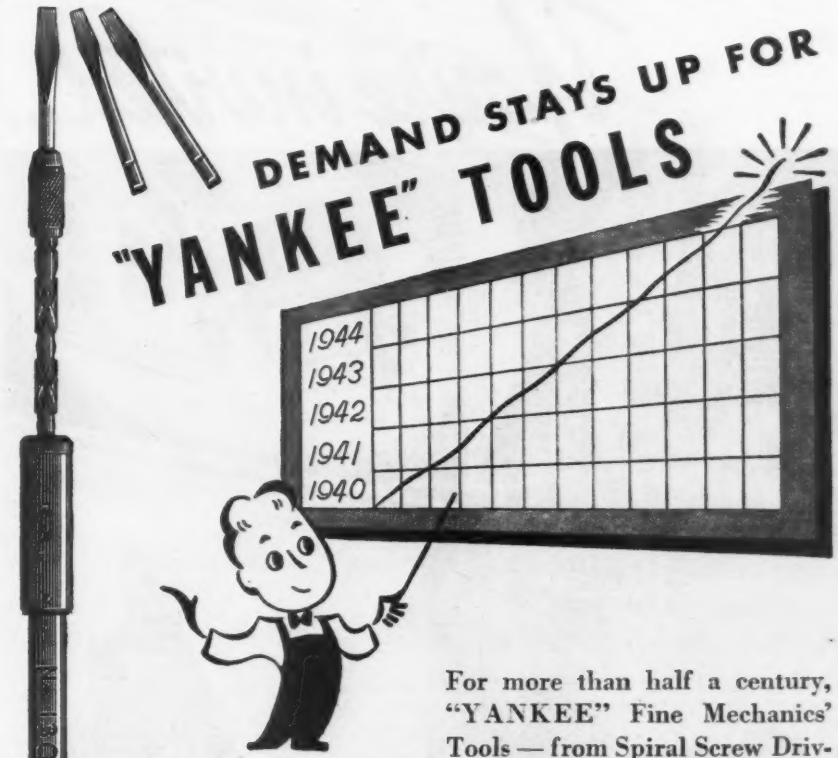
Therefore, we arrive at two fundamental protective phrases: (1) "On the basis of present knowledge," and (2) "with the present type of machine." Performance estimates made with those reservations may be of interest.

Thus far, the Sikorsky R-4 model has achieved a speed surpassing 80 mph. in level flight. This is not fast, and a glance at a picture of the craft will reveal, even to an untrained eye, many places where speed could be increased by better streamlining. We have reason to believe that helicopters will shortly exceed 110–120 mph.

Going back to Mr. Sikorsky's *Atlantic Monthly* article, we find a prediction of 140 mph. for the more distant future. But that is as far as common sense permits us now to think. Research, or a different type of machine, may extend this limit. If so, we may consider it an unexpected dividend. In the meantime, the speed in hand can and will have plenty of useful applications.

As for load, we shouldn't seek too much. A capacity of 8 to 12 passengers appears well within range. An ultimate of 20 passengers is perhaps a reasonable guess. But I am not revealing any secrets when I say that, for best performance, a helicopter should not carry much more than 10 lb. per hp. (The fact that we have done considerable flying with more than 14 lb. per hp. does not alter the basic truth of this statement, because in these instances we sacrificed other good qualities in the interest of load.) About 6 or 7 of those 10 lb. will be structural weight. Therefore, we end up with a balance of 3 or 4 lb. per hp. that can be applied to passengers, fuel, oil, and baggage.

Twenty passengers, plus baggage, weigh about 4,000 lb. Adding the fuel and oil necessary for a reasonable flight, we deduce that somewhere around 2,000 hp. will be required for a 20 passenger



For more than half a century, "YANKEE" Fine Mechanics' Tools — from Spiral Screw Drivers to Tap Wrenches and from Automatic Drills to Bit Braces — have been doing the work they were *designed* to do: saving time, energy, and costs on countless different jobs. "Yankee" ingenuity means faster and easier work. "Yankee" quality means dependable and rugged performance. Remember this when "Yankee" Tools, having done their bit in the shops of war, are again available for the jobs of peace.

Order from your industrial supply distributor, or write North Bros. Mfg. Co., Dept. AV-1144, Phila., Pa.

"YANKEE" TOOLS

make good mechanics better

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Established 1880

ship. A 2,000-hp. helicopter may not be impossible, but it is certainly a long step ahead of what we have so far achieved. Therefore, we are quite content to establish that as our first goal—let come what may thereafter.

Non-stop flying range is, of course, a factor of load. If you wanted to carry the equivalent of 20 passengers in gasoline, you could fly solo far enough to get quite bored with yourself. On the other hand, you could probably carry 30 or more people for a fairly short flight, by the simple expedient of not filling the gas tanks so full. When we speak of load, however, we automatically figure on giving the helicopter enough gas to fly for 3 or 4 hr.—which means somewhere around 300 to 500 mi. non-stop. This is comparable to standard airplane practice, and a helicopter with such characteristics would be a useful vehicle.

So, "on the basis of present knowledge, and with the present type of machine," we feel confident in prophesying satisfactory performance in speed, load, and range. If you don't consider it satisfactory, you are entitled to await the results of the next several years—or do your own guessing.

What about that question of controls? One technically qualified commentator has stated that operating the helicopter requires a greater degree of skill than an airplane, and far greater than a car. He estimates that it will take between five and ten years of further study before the controls will become sufficiently simplified to make the craft suitable for public use.

I am in no position to argue the first part of his statement—if he cares to suggest that I am skillful. I bow a grateful acknowledgment. But I must take issue with his conclusion. There are only two difficulties that stand in the way of simplifying the present controls: First there is the need for applying our entire efforts in other directions; Second, the need for deciding whether the ultimate helicopter controls should be more like those of an automobile or of an airplane. Once the latter decision has been reached, and once we can spend a little time on the matter, I believe that great simplification could be introduced almost overnight.

Persons accustomed to automotive thinking often ask, "How many miles do you get on a gallon of gas?" But in aviation, "miles per gallon" is changed to read "gallons per hour." If a certain airplane uses 10 gal. of gas an hour, and cruises at 120, it will be going 12 mi. to the gallon. But, if it hits a head wind, or rides along on a tail wind, the gas consumed per mile may be greatly altered. That, of course, is why aviation does not think in automotive terms, but refers instead to the gasoline used every hour, regardless of distance covered.

An engine developing a certain power will burn a certain amount of gas per hour, whether it be in a helicopter, an airplane, or a power boat (atmospheric conditions being equal). Therefore, before deciding how economical a helicopter will be, we have to decide what horsepower we are planning to use.

The chances are that a good two-place helicopter will have about 200 hp. (this would be about a 2,000-lb. machine, including passengers, baggage, and gasoline). It will probably cruise about 100 mph. (maybe faster when we learn more) and burn about 11 gal. of gas for every hour in the air. On the average, this gives us about 9 mi. to the gallon.

Before a man makes too many mental comparisons with his 15-mi.-per-gal. automobile, he should bear in mind that when he drives somewhere by car, he often goes several miles farther than the distance as the crow flies. So the helicopter, cutting 'cross lots, will save somewhat on the actual mileage of the trip.

He should bear in mind also that his car will be running about three times as long as the helicopter for any given trip—which means three times the wear and tear on the mechanism. And, finally, he should consider the fact that for each mile his car travels, he is paying a 1c. for tires—which will probably never wear out at all on a helicopter.

Taking all these things into consideration, the comparison is not so unfavorable as it may at first appear—and by the time one charges off a little for time saved, for enjoyment, and for flexibility, the scales swing definitely toward the helicopter.

Why does the two-place helicopter require nearly twice as much horsepower as a two-place airplane? The answer lies in the fundamental truth that you

You're invited...
. . to inspect the home of TURNER gauges
The next time you are in this vicinity we invite you to take a trip through our plant and offices which production experts call ideal for the manufacture of precision equipment. Investigate the well planned working conditions which make the perfection of Turner Gauges possible.
The Stamp of Precision
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cannot get something for nothing. If you are going to want zero airspeed, vertical takeoff, and hovering at places that are 6,000 or 8,000 ft. high, you must have the power for it. Actually, I am not particularly concerned on this point, because I believe the utility of the helicopter will justify the larger engine.

Having thus brought out in the open many negative points about the helicopter's immediate future, the conflict of Hope vs Fact many lead us to wonder just what the postwar era does hold in store. Speaking personally, I became associated with the helicopter in the begining because its horizons appeared unlimited. The further we proceed, the more the outlook expands. Let me conclude with some sober crystal-gazing:

At the present time, and for the immediate future, the helicopter must be considered a military weapon—just like refrigerators, radios, automobiles, and everything else that you cannot buy now. How soon they may again appear on the civilian market will be determined solely by the progress of the war—and my crystal is clouded in this regard.

At the conclusion of hostilities, we shall emerge with some helicopter models, evolved or evolving, that will readily lend themselves to many specialized uses. They will cost a lot of money—I won't estimate how much, because even if dollar values could be relied upon, the price is heavily contingent upon the quantity of production that will have been achieved, and this in turn largely depends on the duration of the war.

Nevertheless, it is a safe assumption hat helicopters will be expensive, and therefore restricted to particular jobs where initial cost is not a primary factor. They will probably be operated by mining and oil companies for prospecting areas that were hitherto inaccessible, such as the jungles of South America or the waste lands of Canada; by geologists and explorers; by airlines and bus companies creating new routes or providing more adequate coverage on old ones; by business establishments (hotels, newspapers, department stores, etc.), capitalizing on the up-to-the-minute service that the helicopter can render; by concerns engaged in crop-dusting, surveying, aerial photography; in humanitarian enterprises for floods, blizzards, hurricanes, and disasters of all sorts; and finally by government agencies for police work, forest and fire patrol, life saving, and emergency missions of a thousand unpredictable types.

These are only a few striking examples of the jobs for which the helicopter of today is entirely suited and in which it would be economically practical almost without regard to what its original purchase price would have to be.

Bit by bit, production quantities and practices could develop to the point where costs would begin to drop. Other buyers could then afford them for less specialized purposes. As these demands are met, prices could again be reduced, and once the snowball was started, it could gather momentum surprisingly quickly, bringing costs down to the point where the helicopter might at last be considered on the "public market."

3 New FEATURES IN ZEPHYR ANGLE DRILLS

THUMB REST . . . makes it easier to hold drill with less fatigue to operator.

ADDITIONAL BALL AND NEEDLE ROLLER BEARINGS . . . non-friction bearings at *all* points.

GREASE RETAINER RINGS . . . hold the lubricant inside the drill . . . keep drill from running dry.

THESE ANGLE DRILLS RUN COOLER, LONGER UNDER HEAVIER LOAD

Again, Zephyr Angle Drills show the way! Add these three new features to all their other advantages and you have the finest drills available:

- Die cast ribbed body
- Non-slip thumb rest
- Spindle is radial and thrust ball bearing mounted
- Ball and needle roller bearings on drive shaft
- Heat treated bevel gears
- Grease retainer rings assure leak-proof operation
- Precision ground spindle and drive shaft
- All bearings and parts interchangeable

Order and compare . . . 45°, 90° and 360° models available.

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ZEPHYR
HIGH QUALITY PRECISION TOOLS

ZEPHYR MANUFACTURING COMPANY
Factory and Head Office
201 Hindry Avenue, Inglewood, California
Dealers located in all principal cities.

Acres of engines for the new B-29 Superfortress are rolling down the production lines at the Chrysler-Dodge Chicago plant. This is one of the plants making the now famous 2200 H.P. Wright Cyclone engine, powering the mammoth bombers which are setting the rising sun.

Each of these engines is given a test cell break-in run. It is then torn down, every part given a thorough inspection, and sent back to the test cell for another test run. Then, sent to an assembly point, it becomes part of the power which will clinch victory for the United Nations.

Wolf's Head Aviation Oil is used for the critical break-in runs of these Superfortress Cyclones. Wolf's Head Oil Refining Company, Inc., Oil City, Pa. — New York 10, N. Y.

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100% PENNSYLVANIA

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The first two steps, though—military use and specialized commercial use—must of necessity cover a period of years. The period may be somewhat reduced if post-war markets justify tooling up for a pre-established output (10,000, 20,000, 50,000 per year), counting on the sales department to clear the shelves. This would be a new experience to aviation, which has generally not produced much ahead of orders. But even if such a step were taken, it would still be several years after the war before a medium-priced helicopter became a reality. And we still would not have approached those "hundreds of thousands" that Mr. Sikorsky mentioned.

In any such forecast of the future, there are so many intangibles that it is safest to indicate them clearly—and then retire to await their ultimate and inevitable solution.

One thing is certain—the helicopter is here to stay. It will have its ups and downs, its protagonists and antagonists. But it has unalterably become a part of our future existence. How soon John Doe, as an individual, may benefit from its services is beyond the power of anyone now to prophesy. But a few years after the war, a more clearly defined answer should be at hand.

Fit As Its Finish

(*Continued from page* 153)

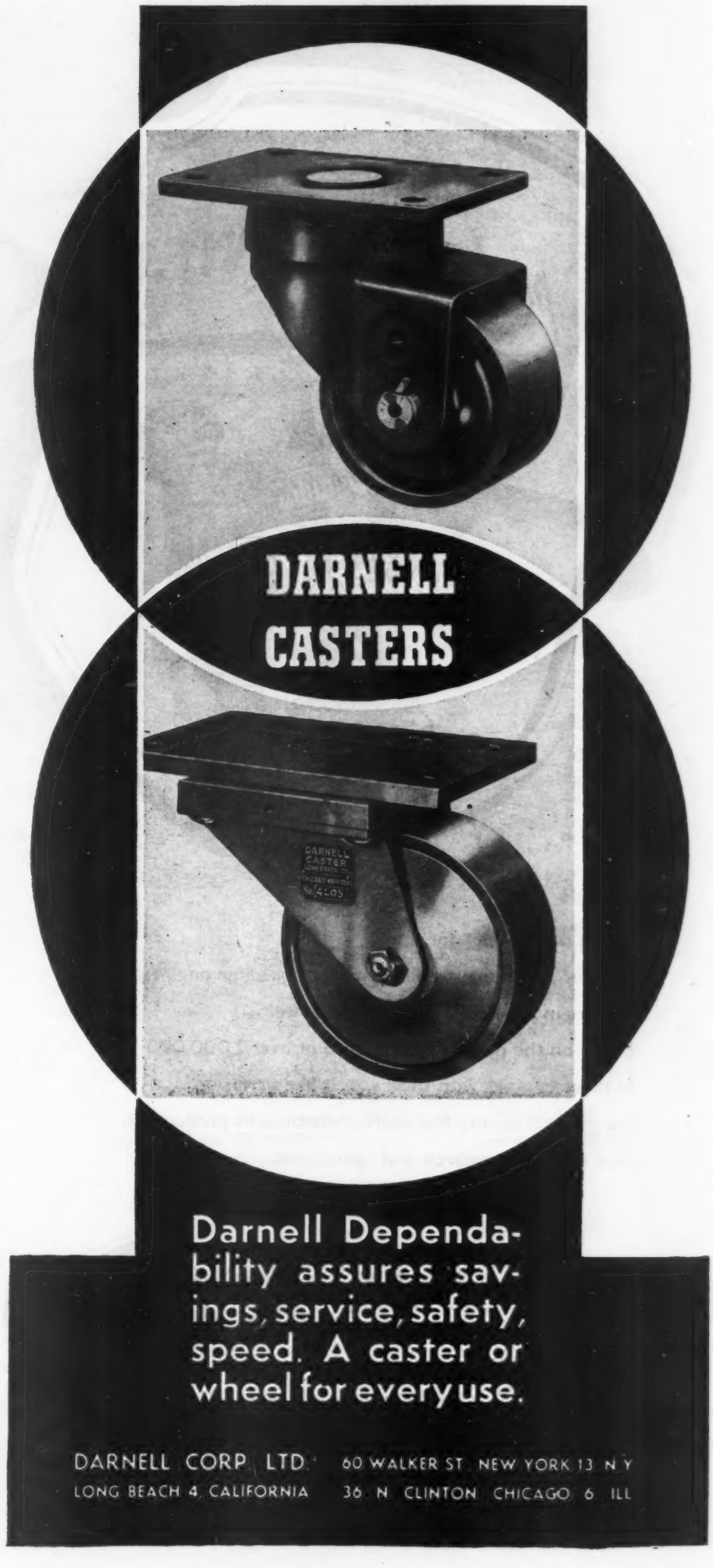
remover of this type are low boilers. The use of low pressure equipment enables the worker to confine the remover to a localized area, eliminating dangerous over-spray and too rapid atomization.

Complete safety equipment such as face shields, synthetic rubber gloves, and hand lotions are provided, and their use is insisted on by the safety engineer.

After the paint is stripped and the surface is ready for cleaning prior to phosphotizing, a cleanup solvent is used. This is made up of acetone, methyl-chloride, and a small amount of sulphinated mineral spirits. For several reasons, this solvent should be applied with rags. First, acetone and methyl-chloride, being low boilers, atomize too rapidly. The cleaning action of these two solvents would be wasted if sprayed. Secondly, the sulphinated mineral oil, which is a higher boiler than the other two solvents, would settle on the surface if spray equipment were used. Synthetic rubber gloves for this hand cleaning operation are a "must."

After a thorough clean-up, the surface should be free of any organic film and in perfect condition for the phosphotizing process which involves the use of a phosphoric acid-type preparation, reduced with equal parts of water. Clean lint-free rags are used, and the areas are worked from the bottom up so as to prevent streaking. The solution is left on the surface for a period of 5 to 10 min. A clear water rinse follows, then the surface is dried. The result should be a clean water-break-free surface that is coated with a film of aluminum phosphate. There is no danger whatever of the solution remaining active or of removing the anodic film.

Too much praise cannot be given this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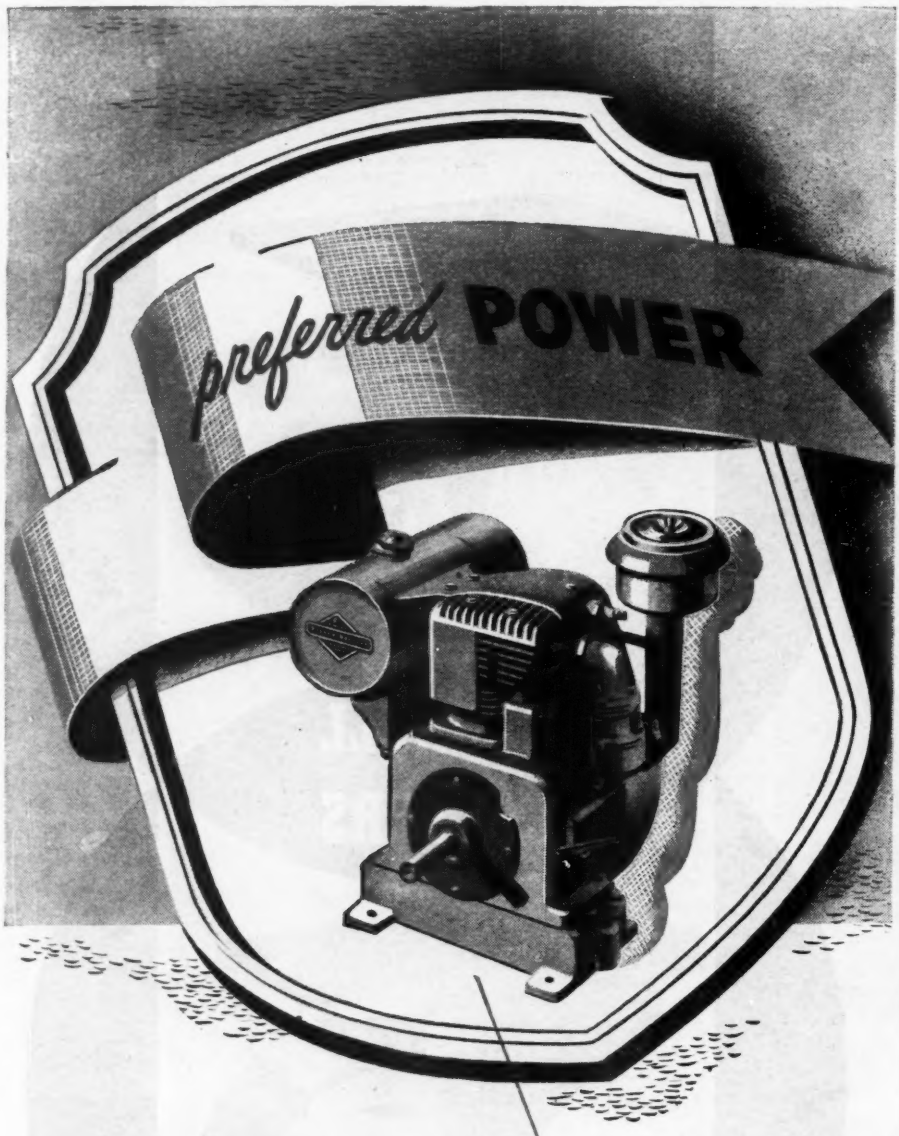

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type of material and method of surface preparation. We believe that it is the main reason for our success in maintaining a sound finish for an almost indefinite time.

From this point on, a quick follow-through with the finish is important. Bare hands should not come in contact with the surface.

But before discussing the type of finish material we use, we might examine an actual twelve-month experience with our preparation. A company flying boat plying the North and South Atlantic air routes, encounters all types of weather at every temperature. In flights to Central and South America and Africa, both the freezing weather of the North and the tropical sun and humidity of the South are encountered. In addition, the bottom of the plane's hull is subjected to great friction and frequent pounding in landing and taking off.

Weight, or rather its absence, is an important factor when fast flying schedules are to be maintained. This is as much a responsibility of the aircraft painter as it is that of the aircraft designer. All of the points—weight, heat, humidity, efficient operation, and the meeting of maintenance schedules—were considered in our decision to take a radical step in the type and application of protective and camouflage coatings.

Ordinarily, after a surface is primed with a coat of Spec. P656A zinc chromate primer, lacquer Spec. M-485 is applied. This latter material is popular because of its speed of drying and ease of application. It may be ideal for production-line work, but our experience shows that it is not satisfactory for fleet maintenance. In line with wartime exigencies, finishing materials have been made more in accordance with the wants of the manufacturers than with those of fleet operators.

Although the paint department has the very latest equipment for controlling humidity, nevertheless, we must paint the aircraft itself out on the huge hangar floor. We only have semi-control over atmospheric conditions there, and at times the outer skin or surface sweats. This, of course, is caused by temperature inside the aircraft differing from that on the outside, plus humidity. Unfortunately, the hangar is located in an area where the humidity is frequently higher than desirable.

At times, we also have found some difficulty in obtaining a satisfactory zinc chromate primed surface. While we are not operating on a production line basis as in factories, we still must meet stringent schedules and are 100 percent on a war basis.

At this point, it may be well to consider briefly the zinc chromate primer and several methods of application. We have always used the aircraft specification P27B or P65A primer. Actually, we found variance in the compositions of different manufacturers, so to keep on the safe side, drying time is kept to as wide a margin as schedules wil permit, which might be from 30 min. up to 24 hr. Through research and the opportunity to observe factory finishes on our aircraft,

we have gained considerable knowledge about zinc chromate. We also realize that the average aircraft manufacturer is forced to farm out different assemblies to outside contractors, which makes it difficult to control the finishing standards.

Application of a correct coat of zinc chromate primer is dependable to a great extent on proper mixture. The proportion of reducer to pigment must be accurate. If a batch is mixed for use over a long period, it is difficult to maintain this proper proportion, because the addition of solvents to off-set the evaporation is sometimes not too accurately done.

For this reason a small, agitated pressure tank, with facility at the bottom of the tank for drawing off only the amount of primer needed for the particular operation, is one piece of equipment that is a big help in accurately maintaining the proper proportions in zinc chromate primer.

Application of a coat of zinc chromate primer is an operation that requires skillful handling of material and equipment. Too many times we have found it necessary to remove the finish from parts of the aircraft that were factory painted and of comparatively recent manufacture. We have "miked up" flaked paint so applied, which gave a reading that varied between 18 and 19 mills. Observations of the chipped sample disclosed that this consisted of about 90 percent zinc chromate primer.

Primer-less Finish

However, by elimination of zinc chromate primer in our finishing process we can credit the saving of this weight, which, in profitable airline operation is a most important factor. In short, after numerous hours spent in removing unsatisfactory chromated surfaces, we finally devised a technique of finishing our flying boats that we believe is foolproof, a method which eventually led to our abandoning entirely the use of zinc chromate primer on the outside surfaces of our aircraft.

Now, after the phosphotizing process is complete, we apply a cross coat of an alkyd resin non-specular enamel, similar to Spec. AN-E-7. The material is reduced approximately 50 percent and is applied with a pressure tank spray unit to a large area at a working pressure gaged according to conditions. For a touch-up we use a siphon cup. Application of this material resulted in a smooth finish less than .0015 in. thick.

We are not recommending or suggesting to anyone, but we have found our methods answer our own problems satisfactorily. We feel that no laboratory testing of flying boat finishing materials can be as severe as the actual day to day test that these materials are subjected to in routine operations. The period of time that our finishing methods have stood up, substantiate our belief in their durability and corrosion resistance.

Does our technique work? We have a very interesting basis of comparison as to the merits of our finishing method as opposed to the standard of lacquer over chromate. Due to the size of our flying boats our stripping operations are done sectionally at each turn-around. On charts of these stripping operations, our new finish was riding side by side with the old finish.

We were able to observe whether corrosion was increased or reduced, whether the wearing qualities were as good as before, and if touch up was as necessary. In every one of these points the described method was superior. In a period now exceeding six months on one of our Flying Ace planes the amount of paint used for touch up has been little. Were it not that inspection demands certain periodic stripping there is no prediction at this time of the life of the finish.

About the only point against the use of this material is its slowness of drying as against that of lacquer. However, this drying time, averaging 3 hr., is not too slow for our purpose. By planning our work we have experienced no difficulty in fitting in this drying time to the scheduled work of our other departments.

In the past year, two entire flying boats have been completely stripped, and the new finish applied. One of the first bottoms so treated is now eight months in use. The finish is still excellent, having corroded less than previously.

This is not meant to be a recommendation for this type of finish. We attribute

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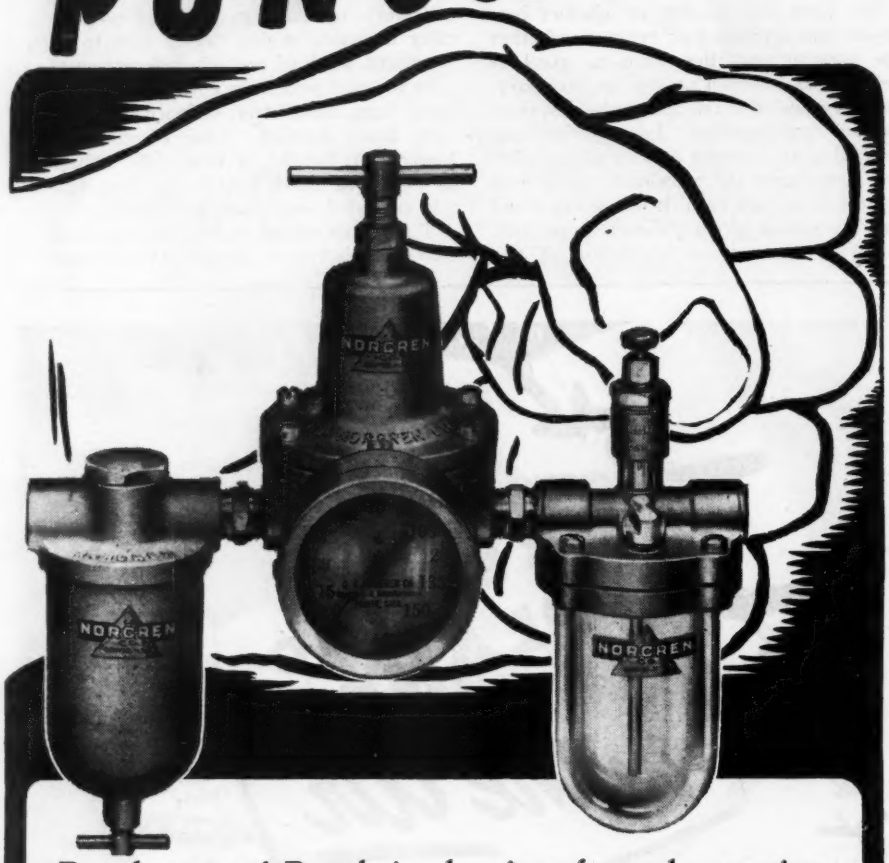

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proper surface preparation as one of the reasons for its success. This surface preparation is such an important factor, that without proper phosphotizing, the life of any finish would be appreciably shortened.

The three important links in the chain of getting a good surface can be summed up as follows: (1) Thorough and proper cleaning inside as well as out, (2) conscientious surface preparation, and (3) the selection of a good finish.

In common with all industries today, we have experienced the usual trouble in getting good, trained painters. To overcome this, the education department of American Export cooperated in setting up a very practical education program.

Classes are held in the hangar four times a week. A course consists of 60 hr. instruction. It is attended by every painter in our department and on his own time. Guest lecturers and technical factory representatives are invited from time to time. Motion pictures in color and sound have been exhibited.

The instructions are given by the foreman of this department. Our greatest difficulty was in getting "green" painters to realize that merely spraying paint did not make a painter. At first, little interest was shown. To them corrosion was something they have to remove. What caused it and how to prevent it seemed outside their province. The same thing was true of finishing materials and the various inorganic processes.

But once their interest was captured they became interested to a point even beyond our expectations. At the present time, electrolytic action is more than a couple of fancy words to them. They understand its meaning and its uncontrolled ravages. The time spent on them has not been wasted, and they expect to go on from here to even higher efficiency.

Intrument Vibration

(*Continued from page* 140)

by the elasticity of the pads, which are so supported that they are free to move in all directions. No bonding of rubber to metal is required since the cushions or pads are retained by a simple and effective mechanical system making possible quick and easy replacement after long service periods.

Accompanying are three photographs showing the comparative vibration neutralizing effects of a Robinson and a conventional four-corner mounting. Vibrometers fastened to the side of each instrument case show the magnitude of the vertical motion when the table is vibrated by the electric motor on the right. Vibration cycles per second and per minute are shown in tachometer between motor and table. It will be noticed (Fig. 2) that the lowest speed, 15 cycles per second (approximating engine idling rpm.) shows very slight vibration of the Robinson amount, which has a harmonic frequency below normal idling speeds. And at the speed shown, it has almost reached the point where motion will not

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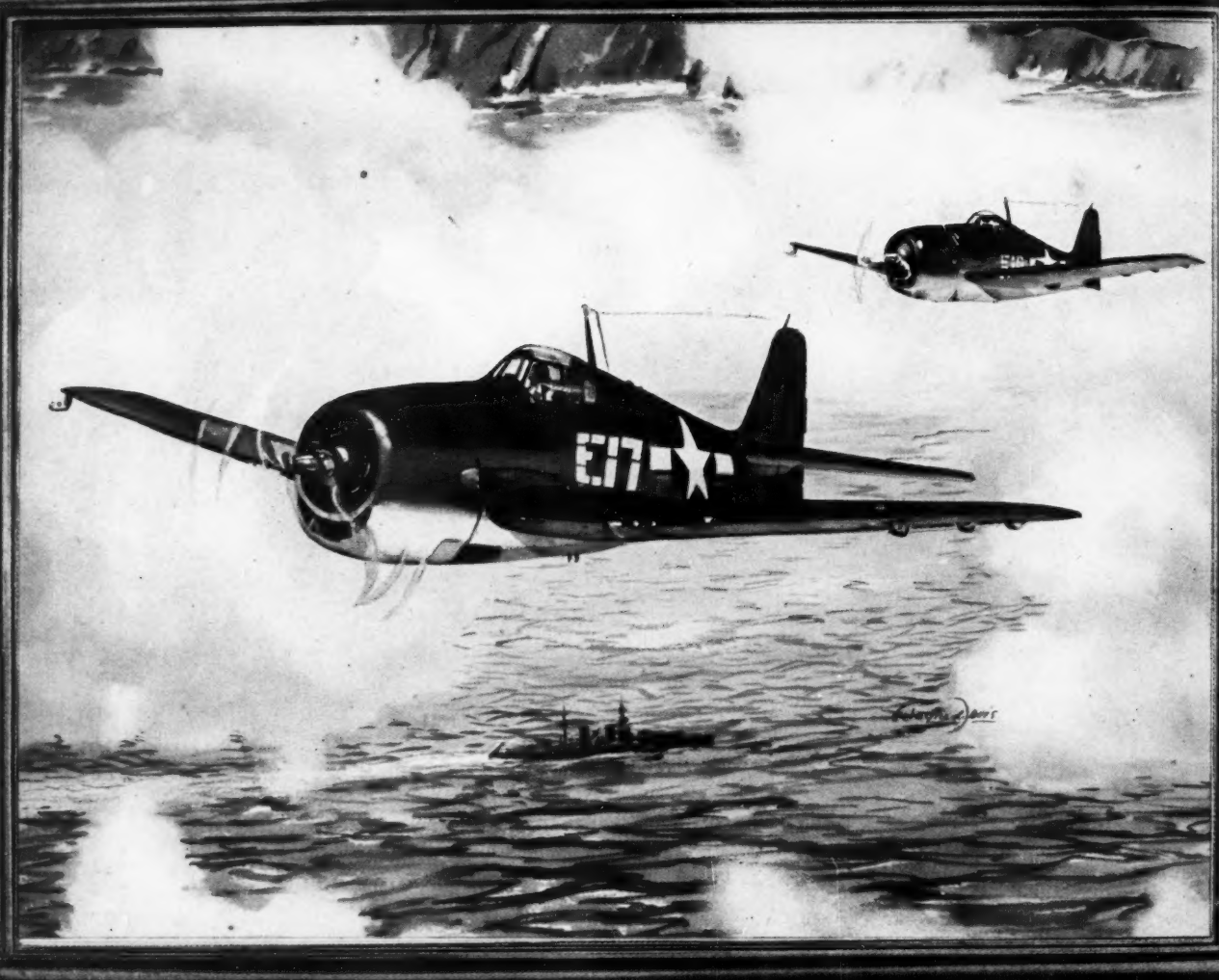

U. S. Navy's Grumman Hellcats Poised for Action

Grumman

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be measurable. The standard mount, however, indicates a very perceptible quantity of both lateral and vertical vibration.

The second picture, (Fig. 3), taken at 20 cycles per second, demonstrates the almost perfect vibration absorption at this speed, as compared to the corner-supported mount on the right, which has a measured vibration of .300 in.

The third picture, (Fig. 4), at 30 cycles per second, is interesting in that it shows slight vibration of the intermediate frame on the Robinson mount, but none in the instrument itself, the slight motion of the secondary frame being entirely cared for by the cushions between the two frames. The standard mounting, however, shows a heavy and violent vibration. This particular speed, 30 cycles per second or 1,800 rpm., is a very important one since it approximates the cruising speed of many airplane engines and a mounting which is not fully effective at this speed transmits destructive vibration hour after hour to the delicate equipment being supported.

Although the units shown being tested are mock-ups of radio equipment, the same comparative results are obtained when identical instrument panel assemblies are tested.

Originally developed as an aerial camera mount, this principle is now used on many bombers to neutralize instrument board vibration (Fig. 5, 6, and 7). In this case the panel is supported by the same double suspension method as previously described, the only difference being that the weight hangs below, instead of resting on, the suspension mount. The stabilizers at the sides are solely for the purpose of preventing side-sway and, except when tilted in flight, have no weight-carrying function.

They'll Fix It—Fast

(*Continued from page* 112)

work by as resourceful a group of Fourth Echelon personnel as one could find anywhere. In one period of ten months that group rebuilt 25 nose sections on heavy bombers, at an average "per plane" time of eight days, using tooling they developed themselves.

Because it illustrates the problems involved and may point the way to an improvement in Fourth Echelon routines, here is the story of that first heavy, which required repair time of over two months.

The nose gear gave way in a particularly rough landing, completely washing out the nose-belly section aft to the bomb bay. Crewmen were dispatched to the scene, and using structural steel angle iron, 2 x 4's, canvas, wire, and available sheet stock, they patched it sufficiently for the flight back to base.

To repair the airframe, the crew first stripped out all of the damaged section back to good, sound structure. Needed piece parts were compiled and an effort made to obtain them. Since none was available, the process of manufacturing them was started.

On the first two or three planes the repair section rebuilt them without assembly jigs. This was accomplished by using damaged parts as patterns to make form blocks. Here, the need for ordinates information was discovered. Parts were assembled in the ship, using plumb bobs, levels, transits, and the like, to align them. This required highly skilled mechanics and was a very slow method of assembly.

While this method of repair was being used, there piled up a considerable demand for better and more accurate form blocks and assembly jigs so the job could be handled more nearly as done in the factory. When an attempt was made to satisfy this demand troubles piled up, due to lack of vital information.

Basic dimension information and loft data are the prime requisites of the tool design departments in the aircraft industry. This is true because basic dimensions and contour information do not appear on production drawings. In the instance related there was available a fuselage station ordinates drawing, but it was for an older model whose forward-end dimensions were 3 ft. shorter.

However, working from this inadequate drawing, the tool design group re-lofted the nose section and established the contour in the forward section of the plane to be repaired. Once this information was established, the work of making templates and form blocks went ahead smoothly and rapidly.

Tooling points were located in piece part tooling and were later coordinated

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into the assembly jig. This jig was not of standard design, since maintenance authorities requested that the jig and required piece parts be so designed they could be flown to areas where other aircraft might have the same trouble, and thereby eliminate the need for temporary patching in the field.

Normally, the design of such a jig would not present too much of a problem, but at this distant station, under present practice, there was a dearth of information, and materials of the right kind were none too plentiful.

Locating the bulkhead rings on station and establishing contour was not too critical, but location of the lower nose gear castings presented a problem, since here the question of interchangeability was involved. For this reason, these points must be held to very close tolerance. At the home factory this would be accomplished by the use of jigs and checking gages.

How it was solved at the East African base makes interesting reading, but the method is not recommended. That part of the nose gear structure which attaches to the lower gear castings was welded to plates and bolted and doweled to the assembly jig; this method will do if this part is satisfactory, but in the event it isn't trouble will be experienced in installing nose gear on all assemblies made with this jig. What should have been used was some gage or check fixture. With a proper set-up this would have been obtainable from the home plant on short notice.

Another difficulty experienced in the jig design was the establishment of a base for referencing to the undamaged structure of the plane. Had there been anyone present who was familiar with the method of tooling this bomber, he could undoubtedly have identified several jig-located points that could be used. Since no such field man was on hand and no tooling data available, solution of the problem took a considerable time and far too much guess-work.

By a process of elimination it was finally deduced which points, by the nature of their functional duties, had to be jig-located. The jig was their built back to those points. Two upper nose gear castings were used as one point, and some pins in the upper nose section, at the point where the Plexiglas nose is attached, became another key point. With these two reference points it was not too difficult to establish reference planes in the jig. From there on, standard jig practice was followed.

When the jig and coordinated piece part tooling were finished, the job of repairing the ship became simplified because tools and materials were available. As stated previously, it took over two months to repair this one airplane before the tools and jigs were built because all cutting and fitting had to be done by hand. Parts were measured, plumbed, and leveled in place. But once the tools and jigs were available the work became almost factory routine.

Because this damage, due to operational conditions then prevalent in the area, became common, the turn-around time of such aircraft in the depot was cut

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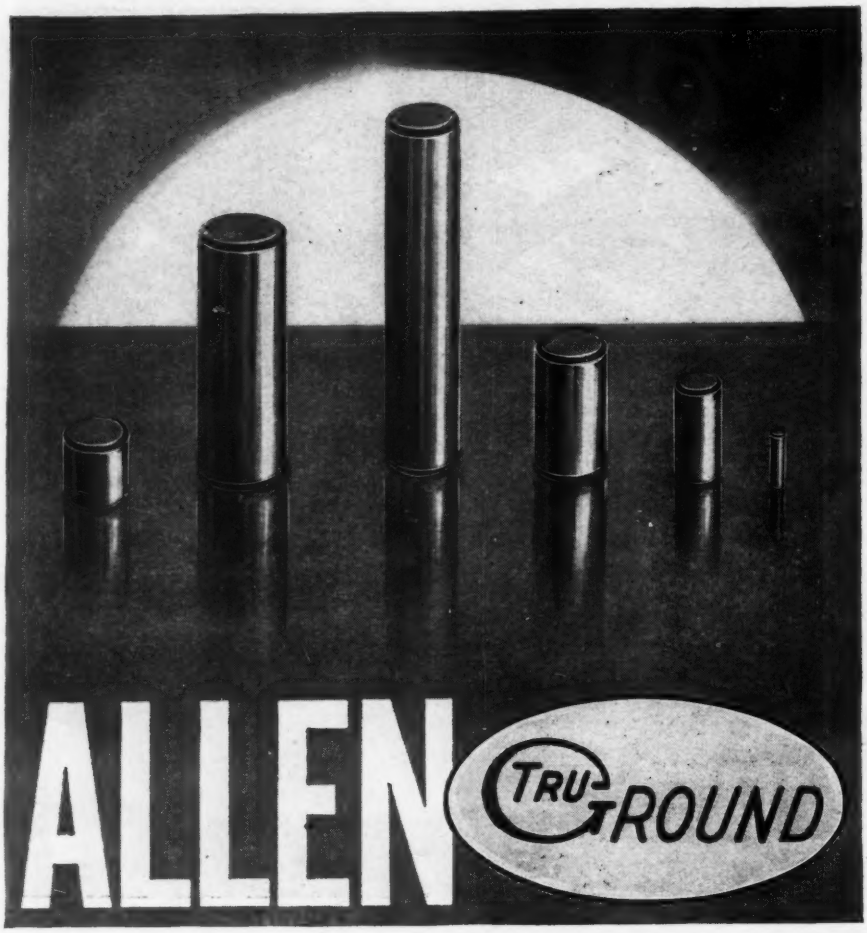

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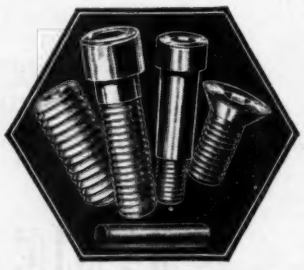

THE ALLEN MANUFACTURING COMPANY
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to an average of eight days. The tooling worked out so well, ASC immediately ordered seven more jigs built, together with some 150 complete kits of piece parts, for this one plane model.

It should be borne in mind that these spare piece parts and jigs were ordered manufactured, not in the parent plant but in a Fourth Echelon depot located nearly half way around the world from the plant of origin of those planes. It is not known to the author whether repair to the extent described was contemplated when provisioning of spare parts was ordered for this particular plane model, but by doing the job at the site, despite existing difficulties, 25 sorely needed bombers were returned to a condition of tactical serviceability, instead of becoming "hanger queens".

This job was not an isolated instance. It was followed almost immediately by the manufacture by "cut and try" method, of an assembly jig and piece part tooling for outer wing panels of a single engine fighter then in use in that theater. This latter project ran into the same difficulty —lack of accurate tooling data. But the problem was solved, and another spare parts and overhaul bottleneck was broken —the hard way.

It might be well to point out here one of the chief disadvantages of the present spare parts system. As everyone knows, fabricating, assemblying, crating, transporting, unloading, storing, uncrating— and finally, all too often, doing considerable rework to make parts fit—calls for tremendous investments in manpower and time, to say nothing of other costs. And with the ever-changing demands of war, by the time spares are in stock, modifications in the plane frequently make parts partially obsolete.

Then, too, past experience indicates that it is most difficult to foresee what quantities of which parts or assemblies will be needed where and when, until damage or wear indicates them. Then, if two to five months are required for obtainance from the States, a considerable number of planes may be grounded before sufficient supply is received. Furthermore, the shipping of large numbers of large assemblies, or even nested parts, takes considerable time, shipping space, and other forms of military investment, while raw stock for manufacture is, in many instances, obtainable locally.

All difficulties can be largely overcome by institution of a system that quickly supplies Fourth Echelon depots with (1) accurate data, (2) special templates and other small tooling, when required, and (3) services of a factory field-service man who is a specialist with production tooling, its design and construction, and production and assembly methods, as well as maintenance and repair. The latter two types of expert service has been rendered by factory field-service representatives ever since American equipment took to the field. The other services likewise could be made available and in the same manner.

However: (1) The need for gages or master tooling items will be determined by conditions at the base doing the work, (2) this will be only a small fraction of

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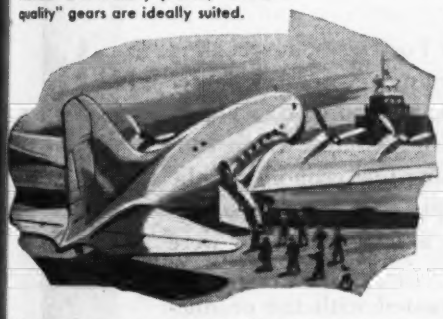

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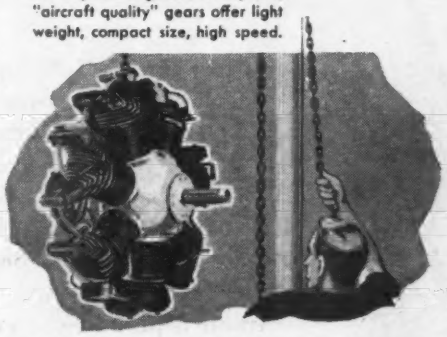

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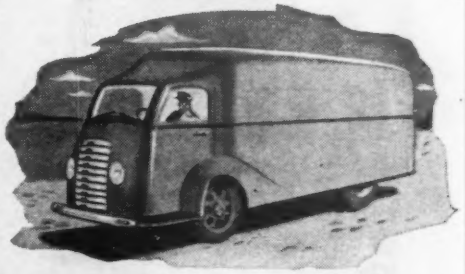
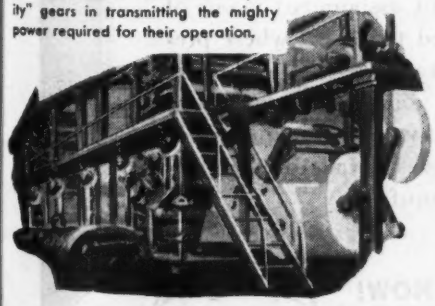


Printing presses can use "aircraft quality" gears in transmitting the mighty power required for their operation.

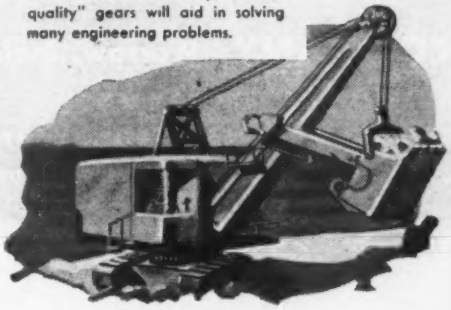


For the manufacturers of Diesel engines, "aircraft quality" gears can help solve many tough power transmission problems.

The demands of machine tool manufacturers for higher speed, lighter weight and compact design recommend "aircraft quality" gears.

Because of their ability to stand up under tough service, "aircraft quality" gears can aid in making tractors better

On construction machinery, "aircraft quality" gears will aid in solving many engineering problems.



FOOTE BROS. GEAR AND MACHINE CORPORATION
5225 S. Western Blvd., Chicago 9, Ill. Dept. G

Please send me a copy of the Engineering Bulletin on "Aircraft Quality" Gears as soon as it is available.

Name.....

Position.....

Company.....

Address.....

City.....*State*.....

Precision Parts for the *AVENGERS of PEARL HARBOR*

THE new Boeing B-29 Super Fortresses, now raiding Japan with increasing frequency, carrry larger bomb loads farther and faster than any other planes ever built. Their Fuel Control Systems, which contribute so much to the amazing fuel economy of the B-29's four 1800 H. P. engines, are built to standards of precision that only a few years ago were considered impossible.

Arnolt is proud to be entrusted with the production of some of the precision parts required for the Fuel Controls. This important assignment is one of several sub-contracts awarded to Arnolt where precision tooling is a vital requirement.

If you need assistance on your production problems, write for a copy of "Available Facilities for the War Program" which gives details on Arnolt's facilities and diversified manufacturing experience.

BUY MORE WAR BONDS—NOW!

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Associated with ATLAS STEEL AND TUBE COMPANY

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Peacetime Builders of

SEA-MITE

MARINE ENGINES

★

the total master tooling or gages used in manufacturing the complete airplane, (3) no tooling will be attempted unless the frequency of specific damage warrants it, and (4) the decision as to what is needed will be the responsibility of the specialist in the area.

There will always be the need for the so-called normal stock of spares—for the normal volume of replacement demand. But practically every theater, and almost every base in such theater, develops what came to be known as common type accidents or battle damage. It is this common or frequently recurring demand for parts or assemblies which could be met in the Fourth Echelon depots, if they had on tap the foremention data, tools and advice.

Accurate data, including that covering tooling and loft lines, is available at the plant of origin. It should be comparatively easy to set up means to quickly furnishing it on request.

In those rare instances where a special piece of master tooling has to be used, it too, should be available. Templates, gages, and other control devices for establishing and checking critical points, would not, for the most part, be large, expensive to duplicate quickly, or difficult to ship by air.

Informed personnel might, possibly, be the hardest to obtain, but one such man at each depot would suffice. Airframe tooling and production methods have become fairly uniform throughout the industry, and it would be unnecessary to station at the depot a representative of each company whose planes were serviced there. Instead, one man would advise and direct such work on all types of planes.

If the system proposed here were established, and the subassembly method of repair were in operation, in the case of the nose section replacement previously cited the following would probably occur:

When structural needs were ascertained, the plant of origin would be asked, via cablegram, for microfilm copies of the data required and such check gages or special tools needed at the depot to assure interchangeability of critical parts. Upon arrival, some days later—surely within a week—the new section would be built and installed.

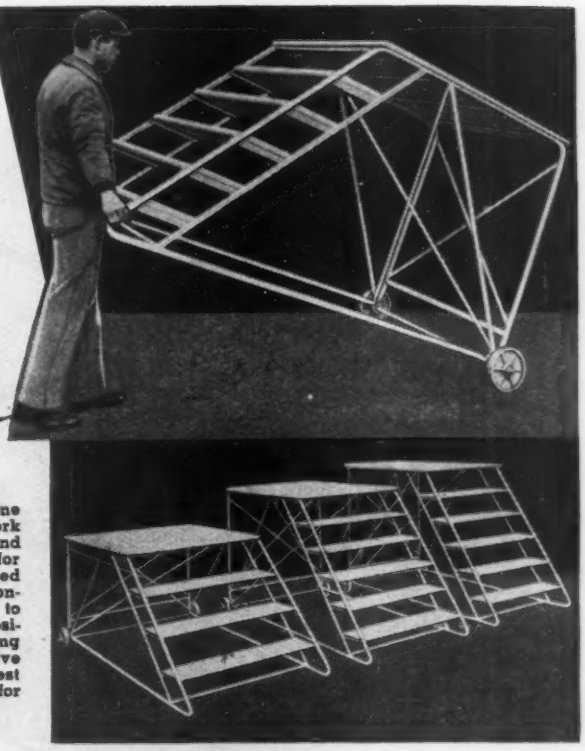
The damaged structure could then be reworked, if not totally destroyed, and placed in stock, effecting in many instances a substantial saving in materials and critical turn-around time for other planes requiring the same replacement. Reworking could be backlog work, done when depot personnel were not otherwise engaged.

It should be noted that it is not proposed that the information and tooling data be made available for equipment. It would be impractical and unnecessary to extend this service beyond airframes, for obvious reasons, but it would be a distinct advantage to have it available for airframes, particularly where great distances were involved. In the Pacific areas, it would help eliminate two of the greatest handicaps to successful prosecution of the air war—time and shipping space.

The airframe companies, a limited in-

Strong Lightweight Tubular Steel

WORK STANDS for Increased Safety AND Portability



The "Wheelbarrow-type" is one of the many Gold Medal Work Stands specially designed and made to specified heights for the Aircraft Industry. Fabricated from steel tubing, it is constructed to put men up next to their work in firm relaxed positions. Carefully placed bracing and supporting members give maximum strength for greatest safety and minimum weight for extreme portability.

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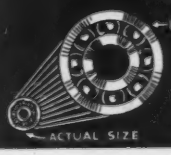
Yes, we employ "female spies" to work for your benefit. They make more than 18 rigid inspections of Miniature Precision Bearings during manufacturing operations — inspections that insure enduring, precision performance of your small instruments. Write for new Catalog, A-11-44 and send your problems to our engineers for recommendations. No obligations, of course.

Radial and Pivot type bearings; outside diameters 5/16" down to 1/8" — world's smallest ball bearings.



MINIATURE *Precision* BEARINGS

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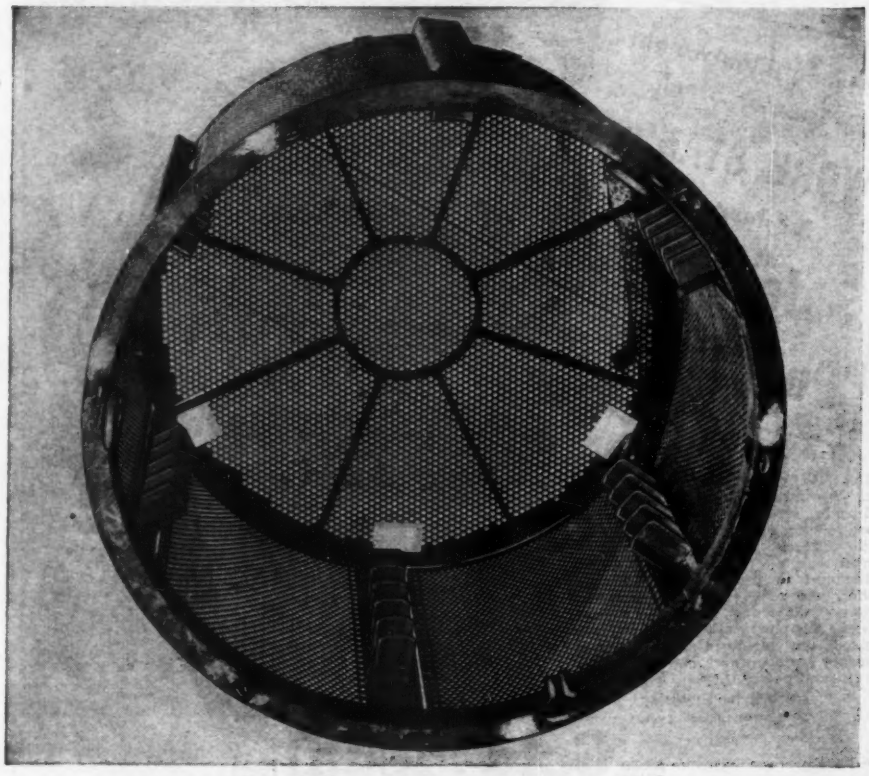

Name Your Size, Shape and Style

Never before has an industry faced the rapid changes in specifications and materials which the aviation plants of the United States have experienced since they started building aerial equipment for war.

Whatever your needs may be, you will find that all P. S. (for Pressed Steel) Carburizing and Heat Treating equipment is ahead of the times in such products as:

- Alloy Exhaust Manifolds
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All of them weigh less than the ordinary—thus are more efficient, more economical, more easily installed.

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vestigation discloses, would welcome the plan, since it would considerably reduce one of their current production-retarding problems—that of spares.

Beam-Approach School

(*Continued from page* 188)

as theory of flight and avigation. They take the controls of a visual Link (a trainer with an open cockpit) and fly by sight, learning the feel of the controls. They are assessed after two weeks, and if their standing is high enough, they do elementary flying in the low-wing Fairchild *Cornells* (now standard RCAF trainers) up to the solo stage. This Link-to-Cornell training teaches them the value of the "synthetic" flight—proves to them that if they handle the controls properly in the Links, they will handle the actual aircraft properly.

They next go to the Instrument Link Squadron, where they are taught synthetic instrument flying, radio procedure, and synthetic operational exercises. For example, they are taught to direct a "fighter pilot" in a Link trainer to hunt down an "enemy bomber", the sort of exercise which lends interest and value to Link trainer work. It is a real test of flying lore. They must watch to see that the "bomber pilot" doesn't cheat by going faster than a real bomber could travel or that the pursuing "fighter" doesn't travel at top speed all through the chase.

In the final stages of the Link course, trainees go into the air again. They do 10 hr. blind flying on instruments, once more learning by experience the practical value of their synthetic training on the Link. To further aid in realism, the RCAF recently installed the first twin-engine Link trainers.

Throughout the course, pupils receive constant tests and are under constant observation as to suitability. It is by far the longest and most complete course ever given Link instructors in North America, the RCAF claims. To study its values the United States AAF, has sent students to Deseronto.

Mexico's Opportunities

(*Continued from page* 184)

Mexico on the Atlantic and the narrow gage Isthmus line to Guatemala), not only was there no airport, but within the memory of man no airplane had ever landed within miles of the place.

However, rumor had it that the Rio Coatzacoalcos regularly forms a sand bar island in its middle each rainy season (just below the high trestled bridge). This was said to be fairly smooth and unobstructed for possible landings during the four months of dry season. Arrival revealed the island dry and narrow, and after a steep side-slip landing, generous measurement showed a landing area all of 500-ft. long by 110 ft. in width. The town's entire population, headed by the President Municipal dressed in full uniform, arrived shortly by fording the river on horseback or else swimming downstream with the swift running current. The

This big black battlecruiser is the first true night fighter

NORTHROP BLACK WIDOW

P-61 NIGHT FIGHTER

You're looking at the largest fighter plane ever built. It packs not just a pilot but *three* fighting specialists.

It is specially equipped to hunt down enemy planes in the dark. And it's "loaded for bear" with a battery of cannon and machine guns which can destroy anything that flies.

The big Black Widow has pursuit ship speed and climb. Yet it is a sweetheart to handle. It can fly securely on only one of its over-2000 h.p. motors. It is specially designed against stalling in the tightest turns —still more insurance for our fliers. And for extra safety on small, dark fields, the Black Widow is built to take off quickly, land very slowly.

That's a lot of performance for a plane as big as a heavy standard transport. But outstanding aircraft design and production is Northrop's trade. As the Northrop group produces the revolutionary P-61 today, Northrop is pioneering still more advanced airplanes for tomorrow.

NORTHROP *Designers and Builders of the* ***BLACK WIDOW P-61 Night Fighter***

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Standard on the "Route of the Flagships"

ARMY E NAVY

In 1939, American Airlines adopted the Collins 17F Autotune* aircraft transmitter as standard equipment for its entire fleet.

Previous experience on a lesser scale had indicated the wisdom of this step. Succeeding experience has confirmed it.

Compared with previous equipment, the 17F's doubled the power output (to 100 watts) with slight increase in weight, and the Autotune* provided thirteen quickly available operating frequencies instead of three.

Daily through the years, these rugged, uniquely efficient airborne 17F's and powerful Collins ground transmitters have given trustworthy support to a superb Operating Department in maintaining the great American Airlines tradition of safety and dependability.

After the war, Collins will again specialize in the development and production of advanced types of communication equipment for commercial aviation.

Its designs will bear the fruit of intense research and outstanding engineering achievement now engaged in meeting the hard demands of military service all over the world. Collins Radio Company, Cedar Rapids, Ia.

*The Collins Autotune is a repositioning mechanism which quick-shifts all transmitter or receiver controls simultaneously and with extreme precision to any one of a number of pre-determined frequencies. U. S. Patents issued and pending.

COLLINS

pleasure of each day's takeoff was greatly lessened by the hazards of gaining access to the aforesaid landing strip.

For the greater part, at any rate, the Republic of Mexico is the pilot's paradise. Or it would be if equipment, service, and landing field needs were brought to standards somewhat equivalent to those in the United States.

Without going into details or statistics, it may be stated that the Republic of Mexico is being adequately supplied with military planes and equipment through Lend-Lease. Civil aviation needs are something else; here no help has been extended. Obviously, such needed assistance in the form of small, practical ships such as Taylorcraft, Piper Cubs, Stinsons, etc., must come from the U. S. No other source is available.

Civil aviation in Mexico is not primarily a matter of pleasure flying. Rather, because of topographical conditions, lack of roads, and scarcity of available space on established airlines, the business executives or other individuals whose work is directly or even indirectly connected with the war effort, must necessarily suffer because of such lack of adequate air transportation or equipment.

Even though persons hold civil licenses to fly and could, by ownership of private planes, extend the activities of their business and, incidentally secure wider distribution of American products—they are prevented from so doing by the fact that no up-to-date planes are available and because those which are here have been flown from three to eight years and in Mexico are sold at prices way beyond ceilings established in the U. S.

Any small utility planes—which by the grace of God or the foresight of some air-minded individual in authority might perchance in the future find their way to Mexico—must of necessity be in sound condition. Because of lack of repair and reconditioning facilities here, not to speak of lack of parts, planes arriving must be in good shape without need of overhaul. Reserve gas tanks are looked upon not as special equipment but as required insurance policies, for Mexico's mountains are legion and have a lean and hungry look.

The old story of Cortés' meeting with Carlos the Fifth, following the former's conquest of Mexico, is brought up to date when describing contour conditions. Asked what the country was like, after detailed discussions of its richness in gold and silver, Cortés paused for a moment and searched for an apt description. Spying a sheet of parchment paper he took it and crumpled it in his fist. Throwing it in front of the monarch he said, "There, Sire, is Mexico!". And so it is—mountains beyond count and in most cases, with hardly postage-stamp space between them to offer refuge for emergency landings.

Today, in all the Republic, there are 600 pilots holding private licenses. But for this number there are only 150 private planes to fly, no more. This is certainly not an enviable situation; it is indicative of present equipment needs. There are no factories, no parts replacements, and not even the opportunity for the people to buy the cast-off planes of their flying cousins to the North. If

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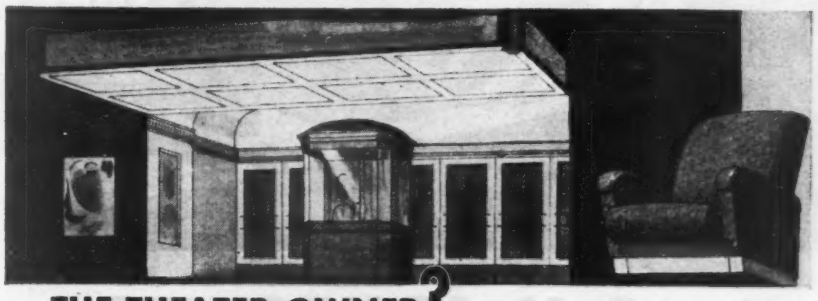
FIRST?

THE TRUCK BUILDER? The new Naugahyde upholstery developed for war service is so wear-resistant it is used in Army trucks and tanks. Battle-tested with toughness to spare, it is perfect for truck seats.



THE THEATER OWNER? The new Naugahyde coated fabrics are so fire-resistant they're used by the Navy—so tough and hard to scuff, they stand almost *any* abuse. They're made-to-order for theater and restaurant seats.

THE PLANE BUILDER? Combine the toughness, long-wear, and flameproof features of Naugahyde with its beauty and choice of colors, and you understand why it is the number one bet for airplane upholstery.

WHO COMES FIRST? *When some of the genuine "U.S." Naugahyde Upholstery (now going into war equipment) is made generally available, perhaps* YOUR *needs should come first. It may happen sooner than you think, so bring your problem to us now. Whatever your needs there will be a Naugahyde upholstery for you that resists wear, looks smart, costs little.*

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only a small part of the huge sums spent on other, often questionable, pursuits were diverted into practical aeronautical channels, where sound results could be gaged in advance, then maybe civil aviation, which after all represents the alert and progressive people of any country, might benefit.

Today in the United States accredited landing fields are common, but the contrary is true here in Mexico. Those first-class fields which do exist were born of necessity—originated through the efforts of commercial airlines, large or small, which have adapted the best spots available for the usual simple landings and takeoffs.

Actually the type and size of landing fields, such as there are, may be gaged by the size and importance of the servicing airline. Where Campañia Mexicana de Aviación, subsidiary of Pan American, lands, there is a first-class field with good space and facilities. Where Panini lands (the majority of its planes are Travel Airs), the fields would, in the U. S., be classed as emergency only. The same is true of Lineas Aéreas Mineras, whose planes are for the most part Lockheed Vegas. The Bellancas of Aereonaves de Mexico use simple landing strips in such isolated places as Tecpan, Petatlán, Zihuatenejo, and Audad de la Union, all in the State of Guerrero on Mexico's West Coast.

This is no reflection on these servicing airlines but rather a compliment to them, for otherwise no facilities whatsoever would exist in the distant centers.

Speaking of gas and oil facilities, the smart pilot will, before taking off for isolated spots, secure through friends or contacts permission to draw on established airline supplies stored at the particular points. Otherwise he will be stranded, or forced to use auto-grade gas, provided it is available.

Here is an actual occurrence which took place recently at the field of Acapulco. The writer arrived in a Taylorcraft for a week-end of swimming and relaxation. His first thought upon landing was to ready the plane for the return trip to Mexico City. However, having neglected to secure permission to draw a modest 40 liters (about 10 gal.) of gas from either airline touching Acapulco, he went into town to buy direct from Pemex, the government-owned utility. The Pemex people were most kind and solicitous, but they regretted that they could only sell aviation gas in drums of 100 liters or more, unless the purchaser brought his own container.

Besides, the offices closed at 1 p. m. on Saturdays—and with 20 min. to go, your correspondent hurriedly visited the town's three hardware stores in an attempt to buy two used alcohol cans of 5 gal. capacity each. Failing in this, a visit to the native market finally dug up the required containers, which had to be cleaned. Also suitable plugs (twisted corn husk), had to be found—after which the gasoline purchase was made and the plane readied for its return trip. This is not a typical case but rather an example of remarkable good luck.

All civil and commercial aviation ac-

AMONG THE *First* TO RECEIVE THIS SIGNAL HONOR!

WAR DEPARTMENT
ARMY AIR FORCES
MATERIEL COMMAND

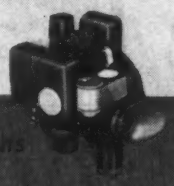
Subject: Quality Control Classification

To: Fairchild Aerial Camera
55-06 Van Wyck Bl
Jamaica, N

U. S. ARMY AIR FORCES' *Approved Quality Control Rating*

This new "Approved Quality Control Rating" is the U. S. Army Air Forces' official expression of confidence. It is assigned to a manufacturer who has demonstrated that its own inspection organization can be entrusted with full responsibility for meeting all requirements of the Army Air Forces. *It eliminates all future need for duplicate Air Corps inspection during fabrication of the product.*

This new honor is a well-earned recognition of the unremitting vigilance of the men and women at Fairchild. Always uppermost in their consciousness is the vital role which Fairchild Aerial Cameras, Sextants, Lead Computing Gun Sights and Radio Compasses perform in our war effort. Thus they have given unstintingly of their energies not only to produce these essential products in the required quantities, but also to maintain that unvarying high quality which is Fairchild.



Fairchild CAMERA
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THE STORY OF AERIAL PHOTOGRAPHY IS THE STORY OF FAIRCHILD CAMERAS

Don't lay that pencil down

. . . till you show where the Short Cut Fastening Method can be used!

Choosing the fastening device for use in the assembly of your post-war product is a very important decision. It should be settled now, while the product is still in the design stage. Too many products are tooled up and ready to go into production before somebody starts to really question fastening methods. This frequently leads to needless expense, troublesome delays, and costly changes.

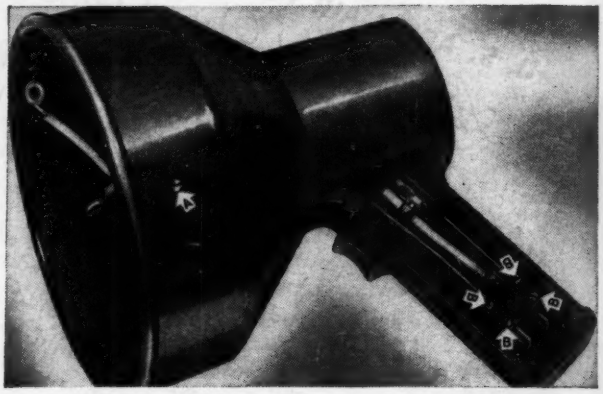
You will want to use P-K Self-tapping Screws whereever possible, because this *short cut fastening method* can save you from 30% to 50% in asembly time and labor! It is the *simplest* way to make most asemblies. You eliminate tapping for machine screws, and tap expense – fumbling with bolts and nuts – costly inserts in plastics – riveting in hard-to-reach places.

Whether you are working with light or heavy steel, cast iron, aluminum, brass, plastics – you'll find you can use P-K Screws to advantage in 7 out of 10 cases.

A P-K Asembly Engineer will help you plan ahead for savings, and you'll find his advice unbiased. He'll recommend only the best Self-tapping Screw for the job, because Parker-Kalon makes *all* types. Write and tell us when you would like him to call, or send details of your fastening jobs for recomendations.

HELPFUL GUIDE – FREE!

The P-K "User's Guide" is crammed full of information on where and how to use P-K Self-tapping Screws, arranged so you can find the facts you need quickly. Write for it. Parker-Kalon Corp., 208 Varick St., New York 14.



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By designing their aircraft lighting specialties for assembly with P-K Self-tapping Screws, this company eliminated tapping and tap expense, and the need for metal inserts. As a result, molding and assembly are faster, costs lower, and fastenings hold with dependable security.

On this inter-aircraft control light –

(A) Three P-K Type "F" Screws are used as locating pins for lamp unit.

(B) Four P-K Type "F" Screws hold switch contactor and terminal lug in position.

(C) Five P-K Type "F" Screws fasten Bakelite handle cover to Bakelite handle. (Not shown.)

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Quality-Controlled
SELF-TAPPING SCREWS

SELF-TAPPING SCREWS FOR EVERY METAL AND PLASTIC ASSEMBLY

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tivities in Mexico are under the direction and regulation of the official governmental department, *Secretaria de Comunicaciones y Obras Públicas.* Some day, when the importance and possibilities of civil aviation will be recognized on a par with the present recognition given to commercial aviation, all these things will be changed—but until then the hapless private pilots of Mexico must carefully estimate chances of completing each flight on the basis of individual initiative alone.

The military phase of flying in Mexico may be passed over with the remark that the military and aviation experts of the U. S. are helping in the thinking, planning, and supplying of the minimum needs of the presently growing Mexican air force. When one considers that in the revolution in 1916 only one plane was occasionally available to the government forces (without changing the results of the fighting) and that now the local military air force boasts some 100 combat planes, it is obvious that real strides have been made. This force is growing daily. Suffice to say that Mexico's military needs are being met and present personnel can give a good account of the time, training, and money expended.

Two years ago, in the parade and demonstration of the 16th of September, celebrating Mexico's liberation from Spanish rule, the local military air force boasted exactly 21 planes, which carried out a simple formation over the 50,000 troops which paraded the city's streets. Recently, in a special demonstration put on for the president and military leaders, the augumented force comprising scores of planes—bombers, fighters, and troop-carrying transports—executed complicated maneuvers reflecting credit on the efforts and results obtained in the intervening two years.

But most of the progress in Mexico must be credited to commercial flying. Almost all of the few airports which exist, the majority of the trained personnel, and existing servicing facilities, must be credited to commercial endeavor. Smartly the laws governing flying activities demand native born personnel to pilot the planes flying within the country. As a result, not only has the Mexican pilot been pushed forward, but results have shown that selections have been uniformly good. All of CMA pilots, aforementioned subsidiary of Pan American, are native stock, and their performance is on a par with the best U. S. can turn out. So far no accidents whatsoever have been chalked up against CMA. But accidents do occur in Mexico, and they may be blamed primarily upon lack of modern equipment, inadequate landing fields, and the absence of up-to-date service facilities.

CMA will take, for example, a recently graduated pilot who shows promise and aptitude and will continue his development under their own instruction facilities. As a co-pilot he has every opportunity to build on inherent ability, and soon he finds himself a full-fledged captain of a minor run. After this his opportunity depends on his own continued ability and steadiness. These commercially trained pilots, avigators, etc., are not siphoned off into military activities for, while Mexico is allied in all war efforts, thus far no actual demands have been made which require hasty expansion of her air forces. Probably better stated is the fact that the air needs of the Allies have been met among the larger United Nations without necessity of drawing on other friendly allies.

In all fairness it should be remarked that Mexico's president, Manuel Avila Camacho, has publicly offered the resources of the country's armed forces, particularly the air arm, in the event such assistance is requested or required.

As remarked previously, all aviation activities (excluding military) come under the control and regulation of *Secretaria de Comunicaciones y Obras Públicas,* under which authority the *Departmento de Aeronautica Civil* passes upon all matters relating to civil flying. The present head of the Aviation Division is Sr. Gral Alberto Salinas, an able and fair administrator. As closely as possible, Mexico has followed the rules and regulations obtaining in the U. S. in outlining her basic control. As a result the visiting pilot need learn few if any new flying rules.

Today's restrictions governing the teaching of flying wisely limit such opportunity to only native born Mexicans or to nationals whose country is allied or friendly to the war effort. Licenses and equipment formerly held by subject

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citizens of the Axis powers have been cancelled and expropriated.

For example, a native of the United States residing in Mexico must, before being granted a learner's permit by the Department, secure from the U. S. Embassy a special letter of permission, after which he can apply for his permit. Naturally he is also subjected to a rigorous physical examination, and during the course of his training he is not permitted to change instructors without written permission from the Department. It is of interest to note that a recent regulation requires negative Wasserman and Kahn tests to permit preflight training and revalidation of existing licenses.

Civil pilot training is 100 percent Mexican instructed, and while the number of teachers is limited, they are excellent. Most of them, at least those attached to the Mexico City Airport, speak English as well as Spanish, but efficiency in learning is more quickly and better obtained through the medium of Spanish itself. In fact, in order to complete the ground school course and pass the required technical examinations of the department, a solid foundation in Spanish is both required and necessary. Practically no aviation schools, as such exist, if exception be made of one recently formed, and for the most part instruction is by individuals who own one or two planes each.

For a country where the airplane is more logically adapted than any other means of transportation; where time factors save days, not hours only, over all other available means; where there is gasoline in abundance and wealth for expansion and investment in aviation activities; and, above all, naturally adaptable personnel—the situation regarding planes available is nothing less than deplorable. Were the average North American pilot, with a few hours or many, to inspect the planes assembled on the line at the ready for daily practice, he would probably be scornful or somewhat apprehensive.

With an over-all population of some 20,000,000, and with 2,000,000 or 10 percent of these resident in the Federal District, Mexico is an impoverished country so far as flying equipment is concerned. Here, too, is concentrated most of the wealth and certainly most of the progressive element to whom flying is a natural development to be learned, enjoyed, and utilized. But such lack is not the fault of Mexicans. They do the best they can with the means at hand. Again, if the prodigious goodwill funds were directed, in only a small part, to civil flying activities, the results could be pre-gaged, justified, and even paid for in advance by an appreciative waiting list.

We have U.S.-made personal craft at the Mexico City Airport. Some are '40 models, but most date back to '38 or even before. Some, still sturdy but no longer stylish, have put in six to nine years of practically everyday flying. Yet these are typical of the planes which are lined up for daily use and which still produce quotas of new students, required hours, and some, if not much, cross-country practice. It is true that during the war,

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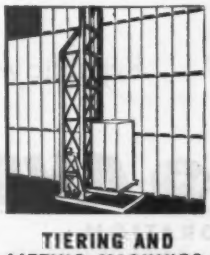
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Created to do things no airplane had ever done before, the Thunderbolt has helped our Air Forces solve one tactical problem after another . . . from long distance bomber escort to dive-bombing and ground strafing. Today, bearing the colors of five United Nations, the Thunderbolt fights on every front and from the remotest outposts.

The Thunderbolt is a complex machine, heavily armed and armored, superpowered, highly supercharged. It weighs more than eight tons. It costs $100,000. It takes 20,000 man-hours to build. It was created and produced in record time in record quantities—10,000 in 27 months—not by a "miracle" but through typical American ingenuity, downright hard work and splendid coöperation by thousands of people—civilian and military.

Republic is proud, naturally, of the technical excellence of the Thunderbolt, of its production record, and of the superlative battle record of the pilots in whose hands it springs to life as a weapon of war.

WRITE THAT BOY TODAY . . . V-MAIL

But Republic is prouder still of the spirit of those Americans who joined hands and brains to build it, and who today press on to new thousands of Thunderbolts . . . and Victory!

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the U. S. is not producing airplanes for civilian use, but because of existing restrictions governing the exportation of even small, strategetically unimportant, used planes, not even planes which might be stored in hangars in the U. S. unused can so much as cross the border for sale in Mexico.

If Mexico, and the same undoubtedly applies to other countries allied in the war effort, goes on being denied available equipment, then the situation is deplorable indeed.

Future flying in Mexico holds many promises, not only in the business world and because of great economic justification, but also for the presently untapped riches available only to such means of transportation. Even today, in the midst of strenuous measures, when all available means are being utilized to bring out precious and needed metals, many important and rich sources are by necessity being ignored.

It may be safely said that no deposits in ores, whether of gold, iron, silver, mercury, mica, copper, lead, etc., now exist which have not been previously discovered and evaluated by the Spanish Conquistadores who arrived here many years ago. Yet, despite the known existence of such remaining, untapped supplies, none of them is available for production because they are inaccessible except by air.

Those which are being worked today produce only in proportion as their output can be hauled away. Those which will be tomorrow's bonanza can only be tapped by access through the only new development in Mexico's last 400 yr.—the airplane. They await only the coming of their airborne discoverer. Each of them (or at least so it seems to passing pilots) has just enough space adjacent to accommodate a small ship. Meanwhile here these opportunities wait—and will go on waiting, unchanged, until such time when civil aviation comes into its own in Mexico.

And so—prospective flyers in Mexico—adjust your stabilizer for the climb and set that mixture lean. You start off high to begin, but there's plenty of room over Mexico. And down below there still remain untold riches in the earth and of it—dreamed of but not yet fully explored by man himself. "Finder's keepers" says the old adage—and who knows whose wings will be the first to cleave the virtually unbroken air in so many as yet unpioneered places.

Curtiss-Wright Transport

(*Continued from page* 120)

profile, is being incorporated in the current military models. Deep side windows are designed to give greater visibility in landing operations, and the windshields are of the "bird-proof" construction recommended by CAA. Double-pane safety glass equipped with defogging nozzles insures clear vision in cold weather.

Every control surface on the new craft is all-metal; on the military version ailerons have been fabric covered. Aerodynamic balance and spring tabs have been

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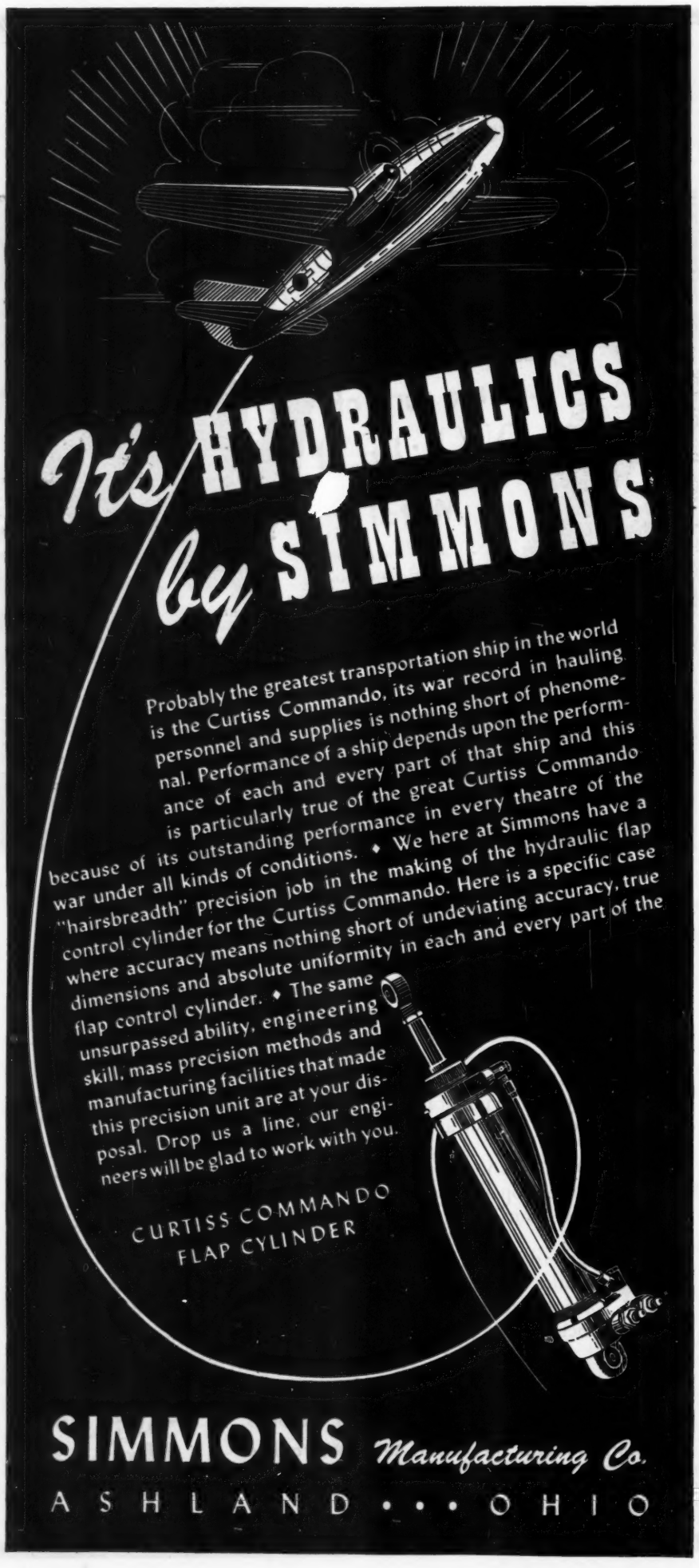
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Probably the greatest transportation ship in the world is the Curtiss Commando, its war record in hauling personnel and supplies is nothing short of phenomenal. Performance of a ship depends upon the performance of each and every part of that ship and this is particularly true of the great Curtiss Commando because of its outstanding performance in every theatre of the war under all kinds of conditions. ♦ We here at Simmons have a "hairsbreadth" precision job in the making of the hydraulic flap control cylinder for the Curtiss Commando. Here is a specific case where accuracy means nothing short of undeviating accuracy, true dimensions and absolute uniformity in each and every part of the flap control cylinder. ♦ The same unsurpassed ability, engineering skill, mass precision methods and manufacturing facilities that made this precision unit are at your disposal. Drop us a line, our engineers will be glad to work with you.
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substituted for hydraulic boost on the controls.

Pilots of major airlines cooperated in setting up pilot's cabin arrangements, which include two seats for pilots and a jump seat for a third crew member. All controls have been located forward to eliminate the need for reaching backward. Both fluorescent "black light" and incandescent lighting are provided.

In the mockup shown correspondents, the galley is located just aft of the pilots' cabin, with a Dutch door between it and the passenger cabin for converting the galley into a serving pantry. A special exhaust duct is designed to keep food odors from the passenger cabin. Finished in polished metal, the galley has a Dutch oven, grill, toaster, mixer, and baby bottle warmer, also a separate counter for a snack bar, as well as usual food-serving equipment.

Passenger seats are arranged in pairs flanking a center aisle. Flush-type ash trays are built into the arm of each reclining chair, and each window has a ledge in the lower frame for small personal articles. An overhead rack for hats and small pieces of luggage runs the full length of the cabin, with individual reading lights and service buttons set in the lower surface. Main cabin lighting is contained in a single fluorescent fixture running the full cabin length.

Stewardess quarters are located just aft of the passengers' seats opposite the left-hand entrance door. A desk incorporates control panel for cabin, vestibule, and lounge lights, and heaters and ventilating system, the latter designed to change the air once every minute.

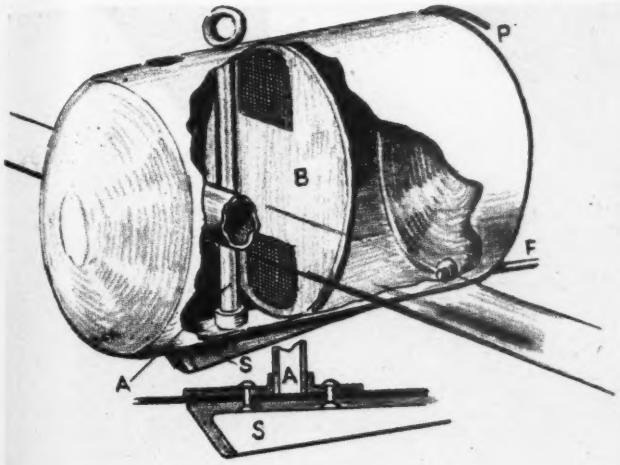
Separate rest rooms have been installed, with windows set above the boudoir table in the ladies' room and flanking the mirror above the wash basin in the men's room.

Mail, cargo, and luggage compartments contain 526 cu. ft. of space, said to be greater per passenger than in any other transport plane. Both compartments are located below the cabin floor, with access through doors on the right side of the fuselage—away from the passenger entrance.

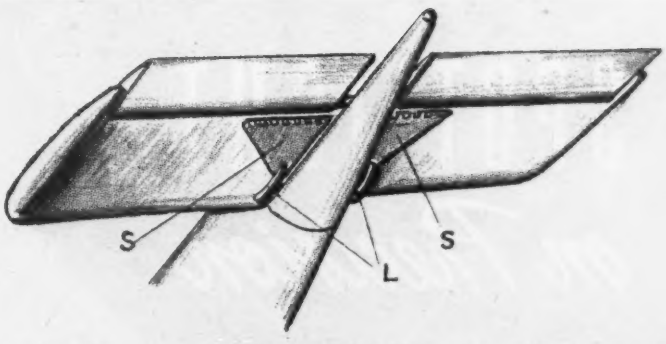
Like its predecessors, the original CW-20 (which is still being used by the British Air Ministry) and the C-46, the CW-20E was designed by George A. Page, Jr., director of engineering for C-W's Airplane Division, and it follows specifications resulting from an extensive survey conducted by the corporation to determine the type of equipment necessary for medium-range transport operations. (Also see AVIATION's Design Analysis of the Curtiss Commando, August, 1943)

Specifications and Data

Passenger capacity	36-42
Span	108 ft.
Length	76.3 ft.
Height	21.7 ft.
Wing area	1,360 sq. ft.
Normal gross takeoff wt.	48,000 lb.
Maximum gross landing wt.	46,400 lb.
Mfgr's. wt. empty	32,100 lb.
Design useful load	15,900 lb.
Maximum payload	12,430 lb.
Cruising speed (10,000 ft.)	242 mph.
Power plant	Two 2,200-hp Wright Cyclone C18-B2
Propellers	Three-blade full-feathering constant-speed Curtiss Electric



Above: Phantom view of fuel tank shows how tubular wing spar passes through it. Lift tube (A) is secured to a plate and to launching shoe (S), a section of which is depicted here to indicate how it acts as a hook. Baffle plate (B) has two openings closed by heavy steel wire screens. Fuel outlet is at (F) and air pressure inlet at (P)



Above: Spoilers (SS) are hinged to bottom rear edge of stabilizer and held down by levers (LL). These are apparently secured by a latch. A spring releases them and at same time apparently locks elevators and rudder. Spoilers blow out and, as they are of different size, undoubtedly put bomb into spiral as it dives.

Nazi V-1 Bomb

(*Continued from page* 191)

the fuel is consumed during flight. The tank has a filler opening at the top, an opening which is closed with a flush-type cap. In the middle of the tank is a 1/6-in. thick vertical baffle plate to reduce surge when launching. Heavy steel-wire screens are welded over the top and bottom openings in this baffle plate. The walls of the tank, of about 1/16-in. steel, form the center section of the fuselage.

The wing is quite thick, about 10-in. deep at the root and 6 at the tip. The over-all width is given by the British as 17 ft. 6 in. The leading edge is nearly straight. Root and tip chords are about 44 and 28 in., respectively.

Wing skin, fully 1/16-in. thick, apparently is welded to the ribs. It is possible that the top and bottom and leading edge were formed, in one piece, with the trailing edge then welded along a transverse seam to complete the wing. There is apparently no dihedral in the wings. Neither are there any ailerons. The wing tips are square and are closed by separate stampings welded to the end of the wing skins.

The spar is tubular and extends from tip to tip through the fuel tank. It is of approximately 5-in. dia., with 1/8-in. wall seamless-steel tube, reinforced by another 1/8-in. wall tubular member rolled around it from a steel strip. This is about 3 ft. shorter than the main spar tube. There is a ⅛-in. gap on the rear neutral axis of the spar where the edges of the strip fail to meet. Here the edges are welded together and to the inner tube at about 1½-in. intervals.

At the tip end of the spar and at two points equidistant between it and the fuselage there are ⅛ x ¾-in. bands, either to reinforce the tubing or the points where the wing ribs are welded to the spar. It is quite possible that with this steel construction only three ribs are necessary between the fuselage and the tip.

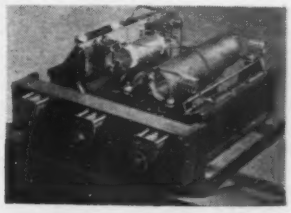
The steel wings appear to lend something of an armor function. The starboard wing of a wrecked bomb, for example, was well creased by machine gun bullets, but it evidently took a shell to pierce it. Even though this shell exploded inside the wing, the skin was only pushed outward about an inch adjacent to the point of explosion.

Contained in the fourth section of the fuselage are two spherical air pressure tanks. These are apparently designed to take high pressure, for they are wound with piano wire and look very much like a housewife's ball of string because of the way the bands are criss-crossed. Each band comprises three layers of 16 strands of about 1/16-in. dia. wire.

The spherical tanks are of approximately 20-in. dia., probably welded at the equator. Taps for air are at the top and bottom poles, and air line connections can be reached through an inspection plate on the port side of the fuselage section. At the rear end of this section there is bolted a ⅛-in. steel bulkhead. This may be part of the automatic control section or a reinforcement to take the thrust of the impulse engine. Each air tank is held in place by a single heavy strap arranged diagonally across the fuselage.

(*Continued on page* 291)

to change frequencies



Most modern ground station transmitters have so many tuning controls that rapid manual or automatic frequency changing is a major problem. The Collins 231C large ground station transmitter contains an amazing device—the Collins Autotune Unit which automatically controls changing frequencies in a matter of three seconds!

A development of the Collins Radio Co. of Cedar Rapids, Iowa, the Autotune Unit has proved of great value in wartime radio because of its flexibility and accuracy. This complex instrument is built with an unusual degree of mechanical finesse. Callite Silver Contacts were chosen for the tap switches driven by the Collins Autotune in the grid and plate networks. This is one of many instances where Callite Contacts contribute to dependable performance in precision mechanisms. Callite Tungsten Corporation, 545 Thirty-ninth Street, Union City, N. J.

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The automatic pilot section apparently contains a horizontal shelf across its middle to support the automatic pilot. A large door is bolted to the upper port quarter of this section of the fuselage to give access to the automatic pilot. At the front end of this section of the fuselage there is a vertical, heavy walled tube supporting the impulse motor. Attached to the top and bottom of the fuselage, this tube has a forked arrangement on the upper end. The fork is fastened with trunnion bolts to the sides of the impulse-engine casting at its horizontal center line.

Last section of the fuselage is a conical member that carries the stabilizer, elevators, fin, and rudder. In it are the air-servo controls which direct and control the elevation of the bomb. A vertical tubular member attached to the rear end of the tail cone forms the back of the fin and the hinge member for the rudder. At its upper end it forms a cradle in which the engine tube rests.

It is not evident whether this is secured to the engine duct, but judging from the red oxide coloring of the duct, it would evidently be desirable to leave it unattached so the duct can expand freely under the red hot operating temperatures at which it appears to function.

According to the British, the air pressure is used to feed the fuel and run the automatic pilot. The light rubber tubes attached to the remains of the automatic pilot would suggest that low air pressure runs the gyros and controls. A pressure reducing valve obviously must be used, although none was visible.

Center line of the impulse engine is about 30 in. above the center line of fuselage, and nose cowling of the engine is of about 20-in. dia., while the tail end of the duct is between 12 or 13-in. dia. The nose cowling apparently takes the entire thrust of the engine and transmits it through the vertical tube to the fuselage. The tube not only drives but supports the heavy steel vertical grill in the front of the engine tube.

On the back of the grill there appear to be a series of quick-acting reed-type valves which are instantly responsive to variations in pressure. Inside the duct, a short distance behind the grill are three venturi passages through which the mixture of air and gas must pass. There are nine fuel jets on the rear surface of the grill. The feed line probably comes from the automatic pilot chamber through the vertical driving tube to the grill jets. The fuel is fed by air pressure.

The English explanation is that the three top jets also include air jets to atomize the fuel. Arrangement of the jets in the grill provides the proper fluctuating supply of fuel to the combustion chamber, it is claimed, and corrects the mixture strength according to the forward speed of the bomb, and also for altitude changes. Nothing was visible of this structure; but from what could be observed, our illustrative sketch was made to suggest how it might be accomplished.

Operation of the engine is very simple. The bomb is launched by a catapult device which gives it a speed of about 150 mph. The air pressure thus built up in front of

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the grill opens the reed valves and air is forced into the combustion chamber. When the valves open up they probably allow the fuel to flow into the air stream through the nine jets in the grill, thus forming an explosive mixture.

In the venturi section there is a spark-plug which starts the combustion. Once the combustion is initiated the subsequent charges are fired by the temperature of the tube walls, heated by the previous charge.

The resultant combustion raises the internal pressure above that on the front of the grill and so causes the reed valves to close. Therefore the products of combustion can only escape from the rear end of the engine duct, giving jet propulsion. As soon as the internal pressure drops below that on the front of the grill, air rushes in again, picks up more fuel, forms a mixture, is ignited, causing the reed valves to close, and the cycle is repeated.

Weight of the complete ready-to-launch flying bomb is given as 4,700 lb. Its speed is variously given from 250 to 360 mph., although the latter figure seems pretty high.

The impluse engine is said to develop 600 hp., if it can be so rated. It consumes eight times as much fuel as a conventional gasoline aircraft engine, according to press dispatches. However, it only requires low-grade fuel instead of high octane gas.

Although the British description of the automatic pilot says there are three air driven gyros, remains of the automatic pilot indicate that it only has two. Since there are no ailerons to operate, a third gyro might be considered unnecessary. The writer has been told that if the two gyros are placed at the proper angle it might be possible to obtain the kind of control which the flying bomb obviously has.

One gyro controls the rudder and has wires which probably connect it to the magnetic compass in the nose. This would provide the means of putting the craft on course, and there must be a control which can be set to determine the final course of the bomb.

The elevator is apparently controlled by another gyro, but it evidently has a barometric capsule control attached in such a manner that it maintains the bomb's flying altitude. One of the control dials on the automatic control had graduations reading 375-400-425-450, etc. This may have been for pre-setting the altitude control. Calibration was judged to be in meters.

The pneumatic servo mechanisms for operating both rudder and elevators look alike. They appear to be die-cast aluminum cylinders of about 1½-in. dia. with about a 2-in. stroke. On the side of the cylinder there is what appears to be a diaphragm housing with control tubes to each side. Each diaphragm must control the valve that causes the servo piston to move. It is obviously a servo mechanism because of a spring attached to the piston rod on one end and probably to the valve on the other end, so that it cuts off the air supply when the correct piston movement has been obtained.

There is much speculation as to how

the flight distance is determined. Some think the supply of fuel carried determines this. Another theory is that when the air pressure fails the bomb falls. Clocks may also be a means of setting off the bomb. Some say a pin wheel device on the nose does it—a method used to arm most bombs.

The clock method sounds quite rational. The failure of air pressure does not seem practical, for there is evidence that air pressure may be needed to lock the empennage controls and release the spoilers when the bomb is ready to be fired. Whether this action also cuts off the fuel was not evident from the wrecked sample, but it is quite possible. This is substantiated by a spring-operated mechanism on the underside of the stabilizer which seems to be released by air pressure before the spoilers can come into action and nose the bomb down.

For starting purposes, there is a valve on the bottom of the automatic pilot section which apparently controls the fuel and ignition. This is operated by a push button and is in the "off" position until the bomb leaves the ramp. Then it is spring-opened, whereupon fuel flows to the grill and an electric ignition switch is closed to spark the engine. This control is a very important part, for the wires are carried through a key-lock switch on the starboard side. This is a tumbler lock operated from the outside with a key, and is apparently a safety device.

It is reported that the bombs are launched from ramps 170-ft. long and of 32-in. gage, but the exact manner in which they are catapulted into the air has not yet been explained. To get the bomb into the air with a terminal velocity of 150 mph. in 170 ft. only requires 1.5 sec. and the application of about 1,000 hp. per sec. Perhaps an explosive charge is used to accomplish this.

Apparently 150 mph. is the minimum speed at which the impluse engine can be started, but once started it has power enough to continue accelerating until it has reached its top speed.

Some of the launching ramps are in a direction other than that toward the objective, thus requiring a timing device—perhaps a spring- or electrically-operated clock used to time both the turn and the total length of flight. This may explain why some bombs have been found with clockworks in them. For the first stage of the flight the compass control must be cut out, but after a certain number of seconds of free flight, the compass control would be automatically connected and the bomb required to follow the preset course under compass control.

Snow and the RCAF

(*Continued from page* 165)

fitted with adjustable blades to level off drifts after severe storms. A stop is provided so these levelling bars may not be lowered to the surface and used instead of the drag. If this bar is set too low it will gouge out sections of the surface due to rocking of the rollers. Adjustable angle-iron drags scarify the surface, reduce the compacted snow, and remove

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ruts. Scarifier teeth on the drags rip up the snow at spring break-up, at which time the crew must give particular attention to temperature forecasts. Sometimes no freezing takes place in the spring, and then no rolling should be undertaken.

During the entire winter the snow-clearing crew must be in close touch with the flight control officer, both to time rolling operations and to keep him informed on the condition of the field.

RCAF has also made use of a combination method of rolling and blowing by which snow is packed 4 or 5 in. deep on the runway. Subsequent snow is all blown off the runway, which never has more than the original depth. When the spring break-up commences, the snow runway is left to disintegrate normally. If a wheel should break through it would make contact with the hard surface beneath. When the snow becomes completely rotten, it is only necessary to scrape it up and blow it off of the runway.

Compacting wet snow during a snowstorm presents special difficulties, because moist snow sticks to the rollers and tractor cleats. To overcome this and insure against interrupted rolling during the snowstorm, a method has been developed using cocoanut matting and a salt solution. Cocoanut matting is nailed to a wooden cross-bar overhanging the roller. The matting is soaked with hot salt water mixed in the proportion of 7 lb. of salt to 5 gal. of water, which will keep a roller in operation for 20 hr.

This method is cheap and easy. It makes possible the complete rolling of an airfield during a snowstorm when the temperature is no lower than 27 deg., making the airfield available for flying immediately after the storm.

For keeping roads in good condition in late winter and spring, the RCAF recommends loosening snow on roads by disking, digging holes in snow drifts to hasten thawing, and using a grader to clear road surfaces and open ditches.

Instrument Overhaul

(*Continued from page* 161)

gases to determine the proper mixture to use for calibrating fuel-air ratio cells.

A collimator for calibration of octants and sextants was also constructed. It is believed to be the only inside collimator in this section of the country. In calibration, this instrument is set on a zero adjustment and checked each 10 deg, through an arc of 90 deg. by sighting of pin-point lights which simulate stars. The brilliancy of these lights is controlled by a rheostat to correspond with the light in the bubble chamber of the instrument. This fixture makes possible the accurate calibration of instruments day or night, rain or shine.

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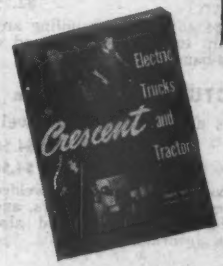

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AAF. In addition, this department has overhauled and calibrated a large number of instruments for both the Naval Air and Marine services, various airlines, our own company's training aircraft, and those of other WTS units.

In 1943 when it was impossible to get replacement instrument dials, the special projects department again contributed by building a mechanical engraving machine. An additional machine was constructed to handle outside contract work, and a third machine was made for the Embry-Riddle Brazilian div. Engraving is done on any flat material.

Reverse type, used to engrave transparent materials on the reverse side, was made in the following manner: The tracing stylus was inverted and the master type placed upside down over the stylus. When this type was traced, the engraving tool produced a master set of reverse type which can now be used in the regular manner. Engraving on other than flat surfaces is done by hand.

Fatigue of personnel due to the exacting nature of instrument overhaul work, and the accompanying effect of this fatigue on production, was found to require consideration. In order to combat this condition, a combination radio and phonograph with automatic record changing device was installed. Latest news flashes, special events, and music are played at frequent intervals.

Equipment was also provided so that coffee, cold drinks, and other refreshments, are available at all times to provide that necessary "lift."

These little things have contributed a specific increase in production, and they have helped to maintain the excellent morale of the department.

Airline Financing

(*Continued from page* 192)

being forced to turn, in 1935, to the Reconstruction Finance Corporation for funds on a chattel mortgage at 5 percent. Later on, Northwest Airlines obtained a similar RFC loan. But those days apparently are over.

It is the practice to fix depreciation charges on present DC-3 equipment on a 5-yr. basis down to a residual value of around $10,000. Bankers point out that by using a similar depreciation rate for the transports now on order, the depreciation carried to a residual value of $50,000 would pay for the financing.

Airline officials have a number of reasons for not liking equipment trusts. In fact, Pan American Airways is the only American air transport concern to adopt this method at any time in the past. John W. Newey, financial vice-president of United Air Lines, has pointed out that all the states have laws covering equipment-trust issues by the railroads, and he feels it would be necessary to get legislation passed to use this form of financing for airlines.

The airlines, he further states, will have additional investments to make in ground facilities to handle larger fleets of bigger planes. Equipment trusts, he

believes, would not be appropriate for that kind of financing.

E. Lee Tarlman, executive vice-president of TWA, also has raised a number of objections to equipment trusts, pointing out that while a box car is a definite entity, an airplane is an aggregate of thousands of accessories and parts which are frequently disassembled and put together again in a totally different combination.

Another drawback is that international law so far has provided no safeguards against the seizure in foreign countries of aircraft assigned to a bank. If a plane financed by a New York bank is impounded by a foreign government, the bank has no way in which to get its property back. It is true, too, that aircraft have a poor re-sale value compared with railroad cars or locomotives—at least that's been the experience in the past.

The fact that some lines look with favor upon bank loans doesn't rule out additional security issues in all cases. The sale of common or preferred stock in some instances may be expected in view of the relatively good securities markets prevailing. American Airlines stock recently sold so high that the dividend yield was only 1.91 percent while the yield on Northwest was only 1.72 percent, also only 1.47 percent in the case of United.

Yet management in several cases is reductant to dilute present common stock equities. United Air Lines has more than 1,500,000 common shares outstanding plus an issue of preferred, while Braniff has 1,000,000 shares outstanding and TWA has nearly as much stock issued. American and Eastern have retained the smallest capitalization of the "Big Four", with less than 600,000 shares outstanding in each case, and a number of the smaller lines are around the 500,000-share level. Although Northwest recently added 117,460 shares, its total capitalization comes to only 356,380 shares.

Pennsylvania-Central Airlines (with its $10,000,000 transport order) and TWA (with its big Lockheed contract) may be the first lines to seek expansion funds. National has indicated that no stock offering is contemplated in connection with its current expansion. All three lines may start the ball rolling by choosing direct bank loans.

Continuous Beams

(*Continued from page* 138)

It will be noted that there is no curve in Fig. 6 from which beam factors C_1''' and C'''_2 can be determined. This is due to the fact that the mathematical equations for these factors, as listed in the appendix, cannot be easily plotted in graph form because they involve both the variables R_a (or R_c) and n, the latter depending on the position of the load.

Continuous beams with concentrated loads are rarely used in aircraft structures. When one does occur it can best be handled as described in illustrative problem 3 (hereafter), or by use of Eq. 19a, 20, and 20a, as discussed in the appendix. (*Turn to page* 299)

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Illustrative problem No. 1: Assume a continuous beam loaded as shown in Fig. 7. The supports are unyielding and the modulus of elasticity, E=10,300,000 psi. is constant. The moment of inertia varies according to the equations:

From A to B: $I_k = 1.8(k+1)^2$ $(k = x/L)$

From C to B: $I_k = 11.25(1-0.2k)^2$

Required: Compute M_b (a) Assuming a constant I in each span equal to the arithmetic mean of the end I's, and (b) by the exact formulas, using the beam factors obtained from Fig. 6.

Solution: Part (a)—Constant I. An inspection of the beam indicates Case 2 for span 1 and Cases 1 and 3 for span 2. Therefore, the equation combines parts of Eq. (1a), (3a), and (5a) as follows:

$$\alpha M_a + 2(\alpha+\theta)M_b + \theta M_c = -\frac{4L_2W'_1\alpha^2}{15} - \frac{L_2W_2\theta}{4} - \frac{7L_2W''_2\theta}{30}$$

or: $\alpha M_a + 2(\alpha+\theta)M_b + \theta M_c = \frac{L_2}{60}\left[16W'_1\alpha^2 + \theta(15W_2 + 14W''_2)\right]$ (a)

$M_a = -40 \times 10 = -400$ in.-lb.
$M_b = -20 \times 10 = -200$ in.-lb.
$W_1' = -.5 \times 12 \times 60 = 360$ lb.
$W_2 = 12 \times 30 = 360$ lb.
$W_2'' = .5 \times 6 \times 30 = 90$ lb.

$I_a = 1.8(0+1)^2 = 1.8$ in.^{4}
$I_b = 1.8(1+1)^2 = 7.2$ in.^{4}
$I_c = 11.25(1-0)^2 = 11.25$ in.^{4}
$(I_b = 11.25(1-.2)^2 = 7.2$ check)

$$I_1 = \frac{1.8+7.2}{2} = 4.5 \quad L_1 = 60 \text{ in.}$$

$$I_2 = \frac{7.2+11.25}{2} = 9.225 \quad L_2 = 30 \text{ in.}$$

$\theta = I_1/I_2 = 0.488$ $\alpha = L_1/L_2 = 2$
$2(\alpha+\theta)M_b = 4.976M_b$
$\alpha M_a = -800$
$\theta M_c = -98$

$16W'_1\alpha_2$	$= 16(360)(2)^2$	$= 23{,}040$
$15W_2\ \theta$	$= 15(360)(.488)$	$= 2{,}635$
$14W''_2\theta$	$= 14(90)(.488)$	$= 615$
		$26{,}290$

$$4.976M_b = \frac{-30 \times 26{,}290}{60} + 800 + 98 = -12{,}247$$

and $M_b = -2{,}461$ in.-lb.
(Answer — Part (a))

Part (b): Varying I — Combining parts of Eq. (2a), (4a) and (6a):

$\alpha C_a M_a + (\alpha C_b + \theta C'_b)M_b + \theta C_c M_c = -L_2C'_1W'_1\alpha^2 - L_2C_2W_2\theta - L_2C''_2W''_2\theta$

or: $\alpha C_a M_a + (\alpha C_b + \theta C'_b)M_b + \theta C_c M_c = -L_2[C'_1W'_1\alpha^2 + \theta(C_2W_2 + C''_2W''_2)]$ (b)

Using duplicate data from Part (a); factors from Fig. 6:

$R_a = I_b/I_a = 4 - C_a = .080$; $C_b = .114$; $C'_1 = .0178$
$R_c = I_b/I_c = 0.64 - C_c = .208$; $C'_b = .465$; $C_2 = .0545$; $C''_2 = .0495$
$\theta = I_a/I_c = 0.16$; $\alpha = 2$
$\alpha C_a M_a = 2 \times .080 \times (-400) = -64.00$
$\theta C_c M_c = .16 \times .208 \times (-200) = -0.67$
$(\alpha C_b + \theta C'_b)M_b = (2 \times .114 + .16 \times .465)M_b = .302M_b$

$C'_1W'_1\ \alpha^2$	$= .0178 \times 360 \times 4$	$= 25.63$
$C_2W_2\ \theta$	$= .0545 \times 360 \times .16$	$= 3.14$
$C''_2W''_2\theta$	$= .0495 \times 90 \times .16$	$= .71$
		29.48

$$.302M_b = -30 \times 29.48 + 64.00 + 0.67 = -819.73$$

and $M_b = -2{,}714$ in.-lb.
(Answer — Part (b))

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Summary: Approximate method: $M_b = -2{,}461$ (error=10.5 percent). Exact method: $M_b = -2{,}714$.

Illustrative problem No. 2: Assume that the continuous beam in problem 1 is further subjected to yielding supports such that $\delta_{ab} = -0.40$ in. (downward) and $\delta_{cb} = +0.04$ in. (upward). Compute the resulting change in M_b.

Solution: Part (a): Constant I (Case 5a).
Eq. (9a): $\alpha M_a + 2(\alpha + \theta)M_b + \theta M_c = \frac{6EI_1}{\alpha L_2^2}(\delta_{ab} + \alpha\delta_{cb})$

$M_a = M_c = 0$ (No end fixity)
$2(\alpha + \theta)M_b = 4.976M_b$ (prob. 1a)
Hence: $4.976M_b =$

$$\frac{6(10{,}300{,}000)\,(4.5)\,(-0.40+2\times0.04)}{2(30)^2} =$$

$-49{,}500$
and: $M_b = -9{,}950$ in.-lb. additional mom. (Answer — Part (a))

Part (b): Varying I. (Case 5b).
Eq. (10a): $\alpha C_a M_a + (\alpha C_b + \theta C'_b)M_b + \theta C_c M_c = \frac{EI_a}{\alpha L_2^2}(\delta_{ab} + \alpha\delta_{cb})$

$M_a = M_c = 0$ (No end fixity)
$(\alpha C_b + \theta C_b')M_b = 0.302M_b$ (prob. lb.)
Hence: $0.302M_b =$

$$\frac{10{,}300{,}000(1.8)\,(-0.40+2\times0.04)}{2(30)^2} =$$

$-3{,}295$
And: $M_b = -10{,}930$ in.-lb. additional mom. (Answer — Part (b))

Summary: Approximate method: $M_b = 9{,}950$ (error=10 percent). Exact method: $M_b = -10{,}930$.

Illustrative problem No. 3: Assume a continuous beam of same spans and moments of inertia as in problem 1, but loaded as in Fig. 8.

Required: Compute M_b (a) Assuming a constant I in each span equal to the arithmetic mean of the end I's, and (b) by the exact formulas, using suitable beam factors.

Solution: Part(a): Constant I. (Case 4a).
Eq.(7a): $\alpha M_a + 2(\alpha + \theta)M_b + \theta M_c = -L_2[P_1\alpha^2 n_1(1 - n^2) + P_2\theta n_2(1 - n_2^2)]$
$M_a = M_c = 0$ (No overhang, no end fixity)
$\alpha = 2$ (prob. 1a)
$\theta = 0.488$ (prob. 1a)
$2(\alpha + \theta)M_b = 4.976M_b$ (prob. 1a)
$P_1 = 40$ lb. $\quad P_2 = 20$ lb.
$n_1 = 15/60 = 1/4 \quad n_2 = 15/30 = 1/2$
$P_1\alpha^2 n_1(1 - n_1^2) =$
$40(2)^2(.25)\,(1-.0625) = 37.5$
$P_2\theta n_2(1 - n_2^2) =$
$20(.488)\,(.5)\,(1-.25) = 3.7$
Hence: $4.976M_b =$
$-30(37.5 + 3.7) = -1{,}236$
and: $M_b = -248$ in.-lb.
(Answer — Part (a))
Part (b): Varying I (Case 4b)
Eq. (8a): $\alpha C_a M_a + (\alpha C_b + \theta C'_b)M_b + \theta C_c M_c = -L_2[C'''_1 P_1\alpha^2 + C'''_2 P_2\theta]$

Since the beam structure is identical to that in problem 1, the factors in the left-hand side of this equation are identical to the analogous factors in that problem, except the values of M_a, M_b, M_c. Hence:

$M_a = M_c = 0$ (No overhang, no end fixity).
From problem 1b — $\alpha = 2$; $C_a = .080$; $C_b = .114$; $\theta = 0.16$; $C_c = .208$; $C'_b = .465$; and $(\alpha C_b + \theta C'_b)M_b = 0.302M_b$. $P_1 = 40$ and $P_2 = 20$

The beam-factors C_1''' and C_2''' cannot be obtained from the curves in Fig. 6 but must be computed by means of Eq. *(18)* in the appendix, which is derived by mathematical integration.

By Eq. (18):

$$C'''_1 = [2.3026n\,[0.5\,(\sqrt{R}+1)\log R - \frac{(A+2/n)\log(An+1)]}{A^3}$$

Wherein $A = (\sqrt{R}-1)$; $R = I_b/I_o$
To obtain C'''_2 substitute $R = I_b/I_o$ and appropriate value for n.
Factor C'''_1:
$n = 1/4$ (prob. 3a); $\sqrt{R} = 2$;
$A = (\sqrt{R}-1) = 1$; $\log(An+1) = \log(1.25) = 0.09691$.
$R = 4$ (prob. 1b); $(\sqrt{R}+1) = 3$;
$\log R = 0.60206$
$0.5(3)\,(0.60206) - (1+8)](0.09691) = 0.90309 - 0.87219 = 0.0390$

$$C'''_1 = \frac{2.3026(.25)\,(0.0309)}{(1)^3} = 0.0178]$$

Factor C_2''':
$n = 1/2$ (prob. 3a); $\sqrt{R} = 0.8$;
$A = (\sqrt{R}-1) = -0.2$; $\log(An+1) = \log 0.9 = -0.04576$
$R = 0.64$ (prob. 1b); $(\sqrt{R}+1) = 1.8$;
$\log R = -0.19382$
$0.5(1.8)\,(-0.19382) - (-0.2+4)\,(-0.04576) = -0.17444 + 0.17389 = -0.00055$

$$C_2''' = \frac{2.3026(.5)\,(-0.00055)}{(-0.2)^3} = 0.0792$$

(From Eq. (8a) $0.302M_b = -30[0.0178(40)\,(2)^3 + .0792(20)](0.16)] = -93.0$
and: $M_b = -308$ in.-lb.
(Answer — Part (b))

Summary: Constant I (approx.): $M_b = -248$ (error=24 percent). Varying I (exact): $M_b = -308$.

Appendix: The curves in Fig. 6, from which the numerical values of the various continuous beam factors are obtained, represent the graphs of the following equations, which were obtained by mathematical integration:

$$\left.\begin{matrix}C_a\\C_c\end{matrix}\right\} = \frac{1.1513\,(\sqrt{R}+1)\log R - 2A}{A^3} \quad (13)$$

$$\left.\begin{matrix}C_b''\\C_b'\end{matrix}\right\} = \frac{(R-1) - 2.3026\,(\sqrt{R})\log R}{(\sqrt{R})\,A^3} \quad (14)$$

$$\left.\begin{matrix}C_1\\C_3\end{matrix}\right\} = \frac{A(\sqrt{R}+5) - 2.3026(2\sqrt{R}+1)\log R}{4A^4} \quad (15)$$

$$\left.\begin{matrix}C_1'\\C_3'\end{matrix}\right\} = 8 + (R-9)\,(\sqrt{R}) - \frac{3.4539\,(A^2-2)\log R}{4.5A^5} \quad (16)$$

$$\left.\begin{matrix}C_1''\\C_2''\end{matrix}\right\} = 5.4\,(R+0.4815) + (R-9)\,(\sqrt{R}) - 1.3815\,(4R+A)\log R/3.6A^4 \quad (17)$$

In these equations, $A=(\sqrt{R}-1)$. Use $R=I_b/I_o$ when solving for C_a—C_b—C_1—C_1'—C_1''; and $R=I_b/I_o$ when finding C_c—C_b'—C_3—C_3'—C_2''.

Not represented in Fig. 6 is the equation of the beam factor for a concentrated load placed at a distance (nL) from the outer support. This equation is:

$$\left.\begin{matrix}C_1'''\\C_2'''\end{matrix}\right\} = 2.3026n\,[0.5\,(\sqrt{R}+1)\log R - [(A+2/n)\log(An+1)]/A^3 \quad (18)$$

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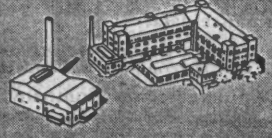
ESTABLISHED  1866

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In the event a continuous beam has a moment of inertia which varies according to the general law, $y=(ax+b)^2$, thus permitting the beam factors C_a—C_b—C_b'—C_c to be read directly from Fig. 6, but whose loading is a combination of concentrated and distributed loads, the beam factors which depend on the type of loading can be more readily determined by mechanical integration (summation).

To perform this operation the basic three-moment equation must be modified to read:

$$\left(\frac{C_aL_1}{I_a}\right)M_a+\left(\frac{C_bL_1}{I_a}+\frac{C'_bL_2}{I_c}\right)M_b+\left(\frac{C_cL_2}{I_c}\right)M_c=-\overline{C}_1-\overline{C}_2 \quad (19)$$

$$\text{or: } \alpha C_aM_a+(\alpha C_b+\theta C'_b)M_b+\theta C_cM_c=-\frac{I_c}{L_2}(\overline{C}_1+\overline{C}_2) \quad (19a)$$

$C_a - C_b - C'_b - C_c$ are obtained from Fig. 6, and:

$$\overline{C}_1=\frac{1}{L_1}\sum_A^B\frac{M_x\,(X)\,(\Delta X)}{I_x} \quad (20)$$

$$\overline{C}_2=\frac{1}{L_2}\sum_C^B\frac{M_x\,(X)\,(\Delta X)}{I_x} \quad (20a)$$

If the moment of inertia of the continuous beam does not follow the general law, $y=(ax+b)^2$, none of the beam factors can be obtained accurately from Fig. 6. However, they can be determined with reasonably close accuracy by a mechanical integration of the following formulas:

$$C_a=\frac{1}{IA_1}\sum_A^B\frac{X\,(L_1-X)\,(\Delta X)}{I_x} \quad (21)$$

$$C_c=\frac{1}{IA_2}\sum_C^B\frac{X\,(L_2-X)\,(\Delta X)}{I_x} \quad (21a)$$

$$C_b=\frac{1}{IA_1}\sum_A^B\frac{X^2\,(\Delta X)}{I_x} \quad (22)$$

$$C'_b=\frac{1}{IA_2}\sum_C^B\frac{X^2\,(\Delta X)}{I_x} \quad (22a)$$

$\left.\begin{matrix}\overline{C}_1\\ \overline{C}_2\end{matrix}\right\}$ See Eq. (20), (20a)

The application of these values requires the general theorem of three moments to be rewritten as follows:

$$C_aM_a+(C_b+C'_b)M_b+C_cM_c=-\overline{C}_1-\overline{C}_2 \quad (23)$$

Accessory Sales

(*Continued from page* 121)

The latter course is obviously the effective one to use.

It is apparent that a distributor's salesman adopting these methods will have little time for hangar flying. Indeed, unless his trips and time are carefully planned, he will have difficulty keeping his schedules. But he will find his customers intensely interested in talking about their own business, he will build sales volume, he will make loyal business friends, and *he will adequately represent the manufacturers whose products he sells.* This is the most important justification of the distributor's preferential discount.

Warehousing Function

It is the distributor's duty to carry in stock sufficient inventory to fill all of his customers' immediate requirements.

While he should endeavor to obtain a maximum rate of turnover through accurate continuous inventory control, this must not be done at the expense of his suppliers. By enabling the manufacturer to ship in job lots, thereby reducing handling, shipping, and supplier's inventory costs, and distributor arms himself with the most effective answer to those proponents of air freight shipments direct from factory to retailer.

Of course the distributor must carry larger inventories than his resale outlets —his inventories must be more complete. This necessarily reduces over-all turnover due to the slow moving items, but it assures him of a reputation for service obtainable in no other way.

The low-margin high-volume staple items, often bulky, are also logically stocked by the distributor and made available to his retailers in smaller units on prompt shipments. This assures the distributor a profit through volume—and the retailer a profit because little of his money is tied up in this low margin inventory. A distributor should never lose sight of potential goodwill in a well managed "stock in trade".

Credit Function

Because the distributor's contact with dealers is necessarily closer than contact which the manufacturer could normally establish, it follows that the distributor acts to eliminate a substantial credit risk to the manufacturer. Not always does a balance sheet, a credit agency report, or another conventional credit medium on which a manufacturer must depend when selling direct, present a true credit picture.

The personal factor is entirely lacking from such media. This factor is usually no problem to the distributor, for he knows intimately his dealers' personal and business habits, his plans for the future, and the policies which govern his conduct. In short, the credit risk is placed where the best judgment can be passed on it. Such an arrangement tends to reduce to a minimum the sales opportunities which are sometimes ignored because of incorrect credit information.

Our present day aircraft accessory distributors may not measure up to all of these requirements, but should not be unduly criticized because of this. It must be remembered that old long-established industries have few resale houses that meet these requirements fully. Considering the length of time they have been operating, today's aircraft accessory distributors deserve a lot of credit for learning so much so soon. It is this same desire and effort towards self-improvement that will make them the leaders in their field and an example for other industries to follow when the war is over.

In the meantime they should receive a full measure of cooperation from the manufacturers who expect to use their services. With present day volume, this may seem to many manufacturers like putting on a complete show for a nearly-empty house. But the cooperation is needed now—not tomorrow—and those manufacturers who do cooperate now will receive their full measure of return in the volume sales of the future.

Nomographs Facilitate Layouts

(*Continued from page* 147)

upper mold points. The apparent angle is found to be 78½ deg. and the small angle ½ deg., which makes the true angle 78 deg. (to the nearest ½ deg.).

Knowing the angle at corner B-C enables us to find the angle at corner C-D from the right triangle relationship—the sum of the two acute angles is 90 deg. Applying this to corner C-D, the complementary angle of 78 deg. is 12 deg. and the figure shows that the bend is open an additional 12 deg., which makes the angle 66 deg. (90 –12 –12).

Our mold point dimensions (to the same side of the part) are:

Mold Point Dimensions	Angles
$A = 0.625$	A-$B = 90$ deg.
$B = 1.500 - \times$	B-$C = 78$ deg.
$= 1.500 - 0.32 = 1.468$	C-$D = 66$ deg.

$$C = \sqrt{(3\text{-}3/4 - 0.040)^2 + (3/4 - \times)^2}$$
$$= 3.778$$
$$D = 0.625$$

With these values we can now proceed to find the developed width; first by bend allowance, second by set-back.

By the bend allowance method, the mold-legs are subtracted from the mold point dimensions, giving the amount of material between the bends. To this we add the bend allowance, since the bend allowance is the amount of metal at the bend. From the nomographs we get the values for mold-legs and bend allowance:

Mold Point Dimensions Less Mold-Legs	
$A = 0.625 - 0.165 =$	0.460
$B = 1.468 - 0.165 - 0.101 =$	1.202
$C = 3.778 - 0.101 - 0.107 =$	3.570
$D = 0.625 - 0.107 =$	0.518
Total	5.750

Bend Allowance	
A-B	0.224
B-C	0.194
C-D	0.164
Total	0.582

By adding the two totals we have the developed width as:

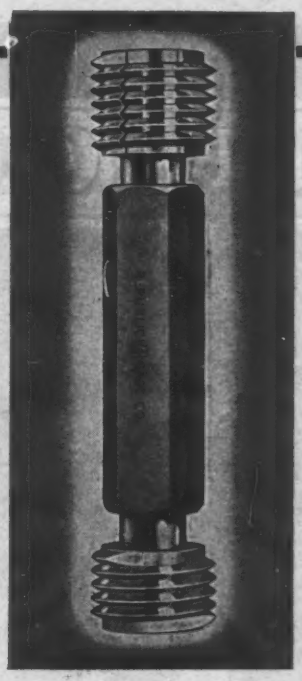
$5.750 + 0.582 = 6.332$

By the set-back method, the total set-back is subtracted from the sum of the mold point dimensions. Care must be exercised to make sure that inside set-back is used where the dimension is to an inside mold point, as is the case with our example at corner B-C.

Set-Back	
A-B	= 0.106
B-C (Inside set-back)	= 0.009
C-D	= 0.050
Total	0.165

Mold Point Dimensions	
A	= 0.625
B	= 1.468
C	= 3.778
D	= 0.625
	6.496 Total
	– 0.165 (Substracting set-back)
	6.331 For the developed width

Note that by the two methods done by



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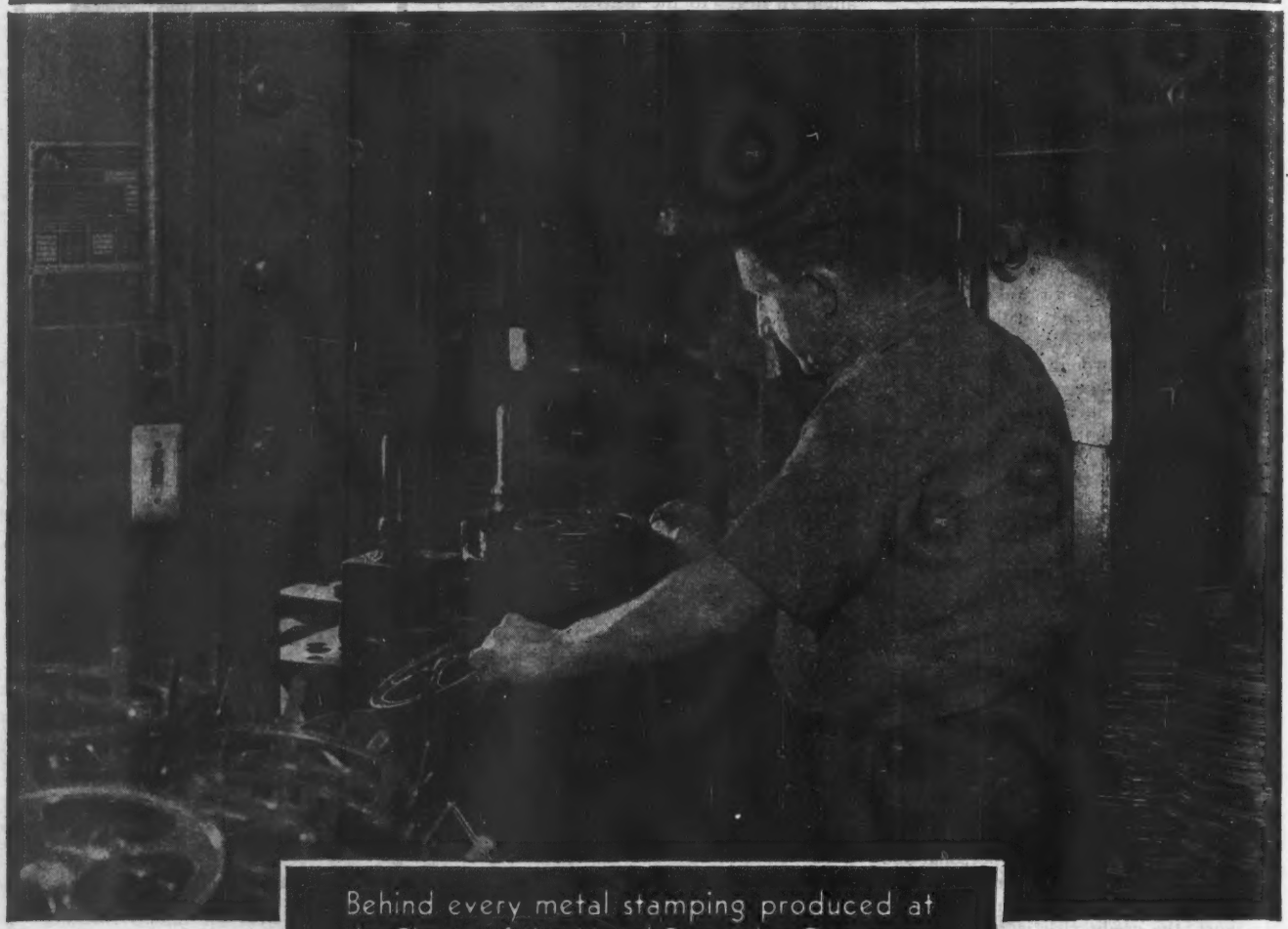

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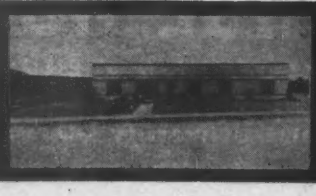

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nomograph, there is only a difference of .001 in. in answers.

2. Form Blocks. Consider a form block to provide a 95 deg. bend for a part to be made up of 0.051 stock with a $\frac{1}{8}$ radius. If the spring-back is 8 deg. for the particular example, the block would be cut to 103 deg. The part's mold leg is found to be 0.261 and the block's mold leg is 0.236 (using the mold-leg chart). The difference between the two is 0.025.

Personal Plane Instruments

(*Continued from page* 123)

will get from such proposed instrumentation will not be due to his ability to fly instruments as we know it today, but rather to the aid that these instruments will give him in accomplishing flights during the extended contact weather, when smoke and haze, rather than cloud or precipitation, provide the restriction in visibility.

Instruments necessary for such flying are four in number: A compass-controlled (or "slaved") directional gyro; an airspeed indicator; an altimeter and, finally, an attitude indicator of a very graphic type, the "flying" of which is extremely instinctive.

Further details cannot be given at this time on the latter device, for reasons best known to the Army and Navy air services. It can be said, however, that during the past three months we have completed exhaustive flight tests with this instrument, whose picturization of flight attitude is so simplified that pilots who had received less than an hour's instruction in its use were flying perfectly executed loops and slow rolls under the hood.

We have taken the liberty of classifying tomorrow's light planes in three categories. We think that, first of all, there will be a basic, Cavu airplane, which will be just a "pure and simple" airplane. This ship will possess a compass, an airspeed meter, an altimeter, and nothing else, except engine instruments. It will fly locally and on short radius flights in excellent weather, and we think it will be the "Model T" of tomorrow's aviation.

The next classification is the utility airplane, a strictly functional means of transportation between airports and landing strips within a 200 or 300-mi. radius. This plane will have a compass, a directional gyro and attitude indicator, an airspeed indicator, and also a two-way radio, including a direction finder for homing.

The third class of airplane will be the ship with large tanks, equipped with all of the instruments mentioned for the utility plane, plus an automatic pilot equipped with a "slaved" directional gyro. And just to show how this latter instrumentation appears from an economic standpoint, we think that it will be bought for less than $450, complete.

In arriving at these classifications we have used the "utility" factor of each plane as the basis for our proposed instrumentation. For example, we believe that the man who customarily flies within 200 mi. of home can get along comfortably with compass-controlled directional gyro and an attitude indicator. And although we will regret its passing, we think that the traditional bank-and-turn indicator, along with the rate of climb, can be dispensed with—for the rate indicators have seen their best days.

In the specifications for the third plane—the long-range craft—you will note that an automatic pilot is included. We believe that for both the professional and the part-time pilot this instrument has proven to be a necessity, a great convenience, and certainly a tremendous factor in its contribution to the safety and enjoyment of route-flying. We think it a necessity because of the sheer relief it will afford the pilot in airways flying under postwar traffic regulations.

We know it is a great convenience in either off-or-on-airways flying on flights of any length, and its contribution to safety during doubtful weather conditions has long since been demonstrated. Further, there is every reason to believe that a dependable automatic pilot for both light and medium-weight aircraft will be available at very reasonable cost in the near future.

One of the questions that must be answered by the light plane manufacturer is whether or not the plane he builds and sells will include instrumentation installed at the factory. Will it be standard equipment, or will it be up to the customer to make these installations after he has taken delivery of his new aircraft?

It would seem much more orderly and sensible (again in terms of utility) for the manufacturer to advocate and supply instruments installed when the plane is built, so as to assure the owner's receiving the proper instruments for his purposes. There was a day when the FOB automobile arrived without spare tire, headlights, or even a self-starter, but it is my considered opinion that this stage in the development of the light plane market could well be dispensed with. Convenience (again) is so much an accepted axiom in the modern marketing of American products that a reversion to the extra accessory philosophy would do nothing but harm the light plane's progress.

The light plane manufacturer and distributor, we feel, must accept a very real responsibility when he sells the man in the street an airplane that is not to be flown by professional airmen. The laws of aerodynamics and gravity will take no holiday upon the arrival of the Air Age.

Designing our layman's plane so that the likelihood of accident is minimized is prerequisite—and sensible, graphic instrumentation with this same responsibility in mind is at least of equal importance. We must utilize every possible opportunity to keep the "Sunday airman" out of trouble, or our market will be in doubt over the years to come.

The man who makes the sale must be candid with his customers to a greater extent than has any other salesman in history. Aside from the safety considerations involved, if a man seeks an airplane for use in extended flying, he should not be sold a craft which is under-equipped in instrumentation. Just one attempt at letting down into a smoke-obscured or

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stratus-covered airport with such a plane will scare him into hangaring his airplane permanently.

There are justified reasons to believe that a good many of tomorrow's light plane owners will be expecting more from their ships than they did in prewar days. The returning military pilot, de-mobilized and back in aviation for fun and utility, will certainly not be satisfied with a Cavu airplane, usable only around the local airport. This pilot will want some real use from his purchase or rental, and if he doesn't get it, he will lose interest, and the industry will have lost a customer.

Instruments of the proper kind, sold at reasonable prices and possessing the required reliability, can do much to insure the progress of the light airplane. The airplane that is not equipped with flight instruments is handicapped at the outset with a loss of usability that can seriously thwart the purposes and hopes of its designers and builders. The distributor who sells such a ship to his customers without complete candor toward them in regard to its limitations is doing the business an injustice.

Instruments will be available for the light plane at reasonable prices and of such design that hours of practice will not be prerequisite to using them.

Review of Patents

(*Continued from page* 210)

Fuel Tank for aircraft, represented as leakproof, crashproof, and self-sealing, has non-metallic, semi-rigid, flexible inner and outer shells between which there is a thin curtain of strong, flexible material. Upon bullet penetration, curtain is caused to move so that hole in it will be out of registration with openings in shells, thus providing a seal.—2,354,701, filed June 19, 1941, patented Aug. 1, 1944, M. G. P. Pescara.

Airport Fueling System embodying main storage tank maintained at atmospheric pressure, and small emergency-use auxiliary supply maintained under air pressure, is particularly adapted for wartime use by design aimed to avoid flooding field if bombs open fuel pit outlets.—2,354,915, filed Mar. 4, 1942, patented Aug. 1, 1944, A. J. Granberg.

Tail Wheel or Skid Mount essentially comprises a wheel axle engaging at opposite ends with side plates of fork mounted in castering relation below housing provided with bracket portion into which is seated lower end of shock-absorbing telescopic strut.—2,355,210, filed Oct. 2, 1940, patented Aug. 8, 1944, E. A. Eddy, assignor to Brewster Aeronautical Corp.

Airplane Flight Indicator has reference pointer initially movable in response to means actuated directly by rudder pedal to indicate turn, and it is continued in movement by means operable in response to inertia forces acting on plane to indicate bank in indicated turn.—2,355,517, filed Mar. 3, 1941, patented Aug. 8, 1944, H. F. De Weese.

Transport Means in aircraft comprises novel lift and turntable structure incorporated for loading and unloading specially adapted armored tank. Means are provided for releasing tank by parachute.—2,356,155, filed Sept. 15, 1941, patented Aug. 22, 1944, C. G. Fogle.

Airplane Pitch Control utilizes dynamic pressure developed by airspeed of plane to set elevators, control being applied to lower elevators, and to decrease angle of climb when airspeed falls below predetermined value, also to raise elevators and increase angle of climb when airspeed rises above this value.—2,356,339, filed Aug. 10, 1940, patented Aug. 22, 1944, J. S. Morrison, assignor to L. M. Harvey.

De-Icer for supercharged aircraft carburetor provides manually or automatically controlled valve in by-pass conduit connecting discharge side of centrifugal compressor to inlet side. When valve is opened, part of air discharged by compressor is reconveyed to inlet side for recompression which supplies additional heat.—2,356,370, filed Feb. 2, 1942, patented Aug. 22, 1944, W. H. Allen, assignor to General Electric Co.

Landing Gear for aircraft embodies mounting in which frictional damping of rotational movement of plunger is limited to predetermined maximum regardless of load acting on strut, to eliminate abnormal conditions resulting from landing members being deflected from true fore-and-aft position.—2,356,468, filed Aug. 11, 1942, patented Aug. 22, 1944, S. M. Parker, assignor to Automotive Products Co., Ltd.

Automatic Steering Device has servomotor connected to controlled member by disengaging clutch so that, with manual steering, motor is not dragged and its friction need not be overcome.—2,356,597, filed Nov. 13, 1940, patented Aug. 22, 1944, A. Kronenberger, vested in Alien Property Custodian.

Special Stabilizer and Elevators for aircraft are intended to improve longitudinal (pitching) control so as to substantially avoid differences in stick forces and balancing of plane, whether in power-on or power-off condition.—2,353,907, filed Aug. 9, 1943, patented July 18, 1944, O. C. Koppen, assignor to General Aircraft Corp.

Directionally Stable Two-Control airplane is designed to be flown by direct manual operation of ailerons and elevator only, directional control being effected with aid of automatically movable rudder or rudders actuated and controlled aerodynamically.—2,353,962, filed July 28, 1943, patented July 18, 1944, O. C. Koppen, assignor to General Aircraft Corp.

Book Reviews

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medium of careful analysis of factors bearing on the subject, with emphasis on labor saving, cost reduction, materials conservation, and increased productivity.

THE AVIATION DICTIONARY FOR BOYS AND GIRLS. Edited by Leslie E. Neville, Editor of AVIATION, Whittlesey House, McGraw-Hill Book Co., N. Y. C. 192 pages, illustrations by Gregorio Prestopino. $2.00.

Because of the graphic simplicity of its explanations of aeronautical terms, this dictionary, though specified for youngsters, should prove to be a handy volume for those in aviation who require brief, clear-cut definitions to give newcomers in the field. Replete with illustrations, the definitions tell "why" as well as "what." Included in the work are a section of military-plane three-views, a section explaining the various types of map projections, and a chronology of aviation history.

AIRCRAFT SHEET METAL BLUEPRINT READING, by Harry H. Coxen, B. S., M. S.; Gerald E. Jackson; and Gilbert Masters. American Technical Society, Chicago. 131 pages, blueprints, graphs, problem answers. $2.50.

Textbook on blueprint reading couched in simple, nontechnical language. Addressed chiefly to workers in aircraft plants, it will, nevertheless, be found of value by tyro technicians in any mechanical trade, particularly those who wish to learn blueprint reading without the requirement of learning how to draw the actual prints.

OPPORTUNITIES FOR YOUTH IN AIR TRANSPORTATION, by Frances Aves Smith and Nickolaus L. Engelhardt, Jr. Air Age Education Research, N. Y. C., 32 pages, illustrations. $.25.

A companion piece to "Into the Air Age," this pamphlet has been prepared for teachers, supervisors, vocational counselors and administrators in elementary and secondary schools and teachers' colleges. Broad in its approach to the subject, it outlines 13 sub-topics, each explaining vital phases of postwar aviation in which youth is expected to play a large part.